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THE UNIVERSITY OF ALBERTA

AN EVALUATION OF THE MATHEMATICS B-OPTION PROGRAM IN ALBERTA

by

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A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

DEPARTMENT OF SECONDARY EDUCATION

EDMONTON, ALBERTA
FALL, 1976

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Evaluation of the Mathematics B-Option Program in Alberta", submitted by Klaus Puhlmann in partial fulfilment of the requirements for the degree of Master of Education.

Thomas E Kieren

Supervisor

Alton T. Olson

Date June 11, 1976

ABSTRACT

The purpose of the study was to evaluate the Mathematics B-option program in Alberta. Stake's model provided the framework within which the variables were evaluated. Eight variables were of particular interest in this study: (1) the mathematics option teacher, (2) the mathematics option student, (3) the nature of the mathematics option curriculum, (4) instructional materials and facilities, (5) instructional activities, (6) time allocation, (7) importance of the general objectives with two objectives being measured (ie. attitudes and creativity), and (8) the effect of the program on the teacher.

Information and data about these eight variables were collected from three different samples employing five instruments. Two hundred teachers were randomly selected from the population of mathematics option teachers in Alberta. These teachers were asked to respond to a questionnaire dealing with all eight variables.

Also, eleven schools participated from nine different school systems throughout Alberta. The mathematics option teachers at these schools were subjected to a structured interview related to their program. From these schools, the investigator also selected at random mathematics option students and non-mathematics option students. These students were matched in number and by grade at each school. Both groups were then subjected to an attitude and creativity test during the first week of February. This was repeated to both groups at the end of May during the same year. In addition to these two tests, the mathematics option students were asked to respond to a questionnaire at the end of May.

Because of the complexity, only some of the results are reported in this abstract. The evaluation revealed that mathematics option teachers had adequate teaching experience and mathematics background.

Their background in curriculum and instruction courses in mathematics was limited, thus finding curriculum development in mathematics option difficult. The majority, however, wanted mathematics option to remain unstructured. More assistance in terms of ideas and suggestions was requested.

Selecting mathematics option was the students' personal choice in only one-half of the schools. Most students were not selected on the basis of strength in mathematics and less than one-half chose mathematics out of interest in mathematics. Most schools had no criteria in selecting students for mathematics option.

Most programs were consistent with the intents of mathematics option. Little overlap of mathematics option content with core mathematics content was observed. While more than one-half of the teachers permitted student input in structuring mathematics option, the majority made little or no use of resources from the community and environment.

Supplies, materials, references and facilities were found to be below an acceptable level.

Instructional activities were primarily of "traditional nature" with few new orientations.

The present time allotment was considered adequate.

Teachers felt that the development of more positive attitudes toward and creative thinking in mathematics were the most important objectives in mathematics option.

Although teachers required more preparation and planning time in mathematics option and despite large enrollments in mathematics option classes, the findings indicated that teachers were generally satisfied with the program.

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TABLE OF CONTENT

CHAPTER PAGE

I. THE PROBLEM IN PERSPECTIVE 1
  Introduction 1
  Background to the Problem 1
  The Problem 2
  Need for the Study 5
  Definition of Terms 6
  Setting of the Study 9
  Evaluation Procedure 9
  Delimitations of the Study 10
  Outline of the Report 11
II. BACKGROUND TO THE STUDY 12
  Theories of Evaluation 12
    Scriven's theory of evaluation 12
    Stufflebeam's theory of evaluation 14
    Taylor and Maguire's theory of evaluation 16
    Stake's theory of evaluation 18
  Some Views on Program Evaluation 24
  Measurement of Outcomes 27
    Attitudes and mathematics 27
    Creativity and mathematics 32
  Theoretical Framework of the Present Study 36
  Summary 40
III. THE DESIGN AND THE EVALUATION PROCEDURE 41
  Introduction 41
  The Function of the Instruments in Stake's Model 41

CHAPTER PAGE

The descriptive matrix 41

The judgment matrix 43

Analysis of Descriptive Data 44

Congruence analysis 44

Contingency analysis 45

Analysis of Judgment Data 48

Statistical Analysis of Data 49

Mathematics Option Teacher Questionnaire 50

Mathematics Option Student Questionnaire 52

Semantic Differential Attitude Test 52

Test of Creative Ability in Mathematics 54

Teacher Interview 55

The Study Population 55

Instrumentation 60

Mathematics Option Teacher Questionnaire 60

Mathematics Option Student Questionnaire 61

Semantic Differential Attitude Test 61

Test of Creative Ability in Mathematics 62

Teacher Interview 62

Sequence of Test Administration 63

Assumptions and Limitations 65

IV. RATIONALE, INTENTS, OBSERVATIONS AND STANDARDS 66

Introduction 66

Rationale of the Junior High School Program in Alberta 67

Intents of the Mathematics B-Option Program 68

Intended Antecedents 69

CHAPTER PAGE

Intended Transaction 71

Intended Outcomes 71

Presentation of Observations 72

Observational Antecedents 72

Observational Transactions 100

Observed Outcomes 109

Statements of Standards 120

Antecedent Standards 120

Standards for Transactions 135

Standards for Outcomes 138

V. CONGRUENCE ANALYSIS 140

Introduction 140

Congruence of Observations with Intents 140

Antecedent Variables 140

Transaction Variables 148

Outcomes 150

Congruence of Observations with Standards 152

Antecedent Variables 152

Transaction Variables 178

Outcome Variables 182

VI. CONTINGENCY ANALYSIS 184

Introduction 184

Null Hypothesis 1 184

Null Hypothesis 2 188

Null Hypothesis 3 191

Null Hypothesis 4 193

CHAPTER PAGE

Null Hypothesis 5 196

Null Hypothesis 6 199

Null Hypothesis 7 202

Null Hypothesis 8 205

VII. EVALUATION BY SCHOOL 207

Introduction 207

School One 208

School Two 216

School Three 222

School Four 229

School Five 235

School Six 245

School Seven 252

School Eight 262

School Nine 271

School Ten 279

School Eleven 285

VIII. JUDGMENT AND SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS . 293

Introduction 293

Judgment with Regard to Congruence 293

Observations with Intents 293

Observations with Standards 297

Summary of Observations 304

Summary of Conclusions of Contingency Analysis 308

Question 1 308

Question 2 309

CHAPTER PAGE

Question 3 309

Question 4 310

Question 5 310

Judgment with Respect to Analysis by School 311

Recommendations 323

Concluding Thoughts 327

BIBLIOGRAPHY.................................... 328

APPENDIX

A. Summary of Participating Schools and School Systems by Grade and Sample Size 334

B. Letter to Superintendents, Cover Letter for Teacher Questionnaire and Follow-up Letter to Teachers 337

C. Directions for the Teachers for Test Administration at TIME 1 and TIME 2 341

D. Pilot Study, Report for Mathematics Option Teacher Questionnaire, Mathematics Option Teacher Questionnaire .. 346

E. Pilot Study Report for Semantic Differential Attitude Test, Semantic Differential Attitude Test 361

F. Pilot Study Report for Mathematics Option Student Questionnaire, Questionnaire for Students in Mathematics Option 375

G. Directions for Administering Creativity Test at TIME 1, Creativity Test TIME 1, Directions for Administering Creativity Test at TIME 2, Creativity Test TIME 2, Summary of Test Norms 381

APPENDIX

H. Teacher Interview Instrument, Interview Procedure 394

I. Varimax Rotated Factor Loadings by Concept of Scales belonging to the Evaluative Dimension at TIME 1 and TIME 2 399

LIST OF TABLES

TABLE PAGE

3.00 Classification of Responses to Questionnaire 56

3.01 Summary of Breakdown of Teacher Sample 59

3.02 Summary of Sequence of Test Administration 64

4.00 Distribution of Teachers by Teaching Experience in Junior High School and in Mathematics Option 73

4.01 Distribution of Teachers by Number of University Math. Courses 74

4.02 Distribution of Teachers by Number of Curriculum and Instruction Courses in Mathematics 75

4.03 Distribution of Teacher Responses Related to the Question of Assignment Procedure in Mathematics Option 76

4.04 Distribution of Teachers' Judgment Regarding their Adequacy of Preparation to teach Math. Option 77

4.05 Distribution of Teachers Responses Judging the Difficulty Level of Curriculum Development in Math. Option 78

4.06 Distribution of Teacher Responses to the Question of Student Assignment to Mathematics Option 79

4.07 Distribution of Student Responses to the Question Regarding the Reasons for their choice of Math. Option ... 80

4.08 Distribution of Student Responses to the Statement "Taking Math Option was my own free choice" 81

4.09 Distribution of Teacher Responses to the Question of Grouping Math Option Students 82

4.10 Distribution of Teacher Responses to the Question of the Characteristics of Math Option Students 83

TABLE PAGE

4.11 Characteristics of Math Option Students in Relation to Non-Math. Option Students (Teacher Responses) 84

4.12 Distribution of Teacher Responses as to the Type of Math. Option course they offered 86

4.13 Distribution of Teacher Responses Regarding their Judgment of the extent to which students contribute to the Selection of Curricular Content 87

4.14 Distribution of Teacher Responses to the Question on how Students help to structure the Math. Option Program 88

4.15 Distribution of Teacher Responses to the Question of Overlap of Mathematics Option Content with core Mathematics Content 89

4.16 Mathematics Option includes Topics that are taken in the Regular Mathematics Program (Student Responses) 90

4.17 The Extent to which Resources of the Community and Environment are used in Mathematics Option 91

4.18 My Mathematics Option Program provides for the Needs, Interests and Abilities of: (Teacher Responses) 92

4.19 Distribution of Student Responses to the Question of being allowed to work in Areas of Interest in Math Option 93

4.20 Mathematics Option should continue to be offered the Way it is (Student Responses) 94

4.21 Other Courses should be organized in the same way as the Mathematics Option (Student Responses) 95

4.22 Distribution of Teacher Responses to the Ratings of Materials and Facilities 98

TABLE Page

4.23 Student Responses "we have always enough materials and facilities for projects in Mathematics Option" 99

4.24 Rank Order of Instructional Modes According to their Observed Frequency of Use in Mathematics Option 102

4.25 Distribution of Student Responses to the Question of the most frequent Arrangement in Grouping for Math. Option Instruction 103

4.26 Distribution of Student Responses Regarding the Basis of their Teacher's Marking in Mathematics Option 105

4.27 Distribution of Student Responses Regarding the Fairness of their Teacher's Method of Marking or Grading Mathematics Option 106

4.28 Distribution of Teacher Responses to the Question of Total Time per Week Allotment to Mathematics Option 107

4.29 Distribution of Student Responses to the Question of Sufficiency of Time in Mathematics Option 108

4.30 Distribution of Teacher Responses Regarding the Length of their Mathematics Option Program 109

4.31 Rank Order of sixteen Objectives based on the Mean Score of the Ratings 111

4.32 Distribution of Student Responses to the Statement on the Clarity of the Objectives of their Math. Option program... 113

4.33 Distribution of Teacher Responses to the Statement that "Students work well with little supervision in the Math. Option 115

TABLE PAGE

4.34 Distribution of Teacher Responses to the Statement that "There are more Discipline Problems in the Math. Option than in Core Subjects" 116

4.35 Distribution of Teacher Responses to the Statement that "Lesson Preparation and Planning in the Math. Option require more Time than in any other Subject" 117

4.36 Distribution of Teacher Responses to the Statement that "There is greater mental and physical Strain on Teachers teaching Math. Option than on Teachers teaching core subjects 118

4.37 Distribution of Teacher Responses to the Question of Enrollment in Mathematics Option Classes 118

4.38 Distribution of Teacher Responses Regarding the Level of Satisfaction of Teachers in the Math. Option 119

4.39 Teacher Responses to the Question: "How many Years of Mathematics Teaching Experience at the Junior High School Level would you consider necessary before teaching the Mathematics Option?" 121

4.40 Teacher Responses to the Question: "What would you consider a minimum number of University Math Courses in order to teach the Mathematics Option?" 122

4.41 Teacher Responses to the Question: "How many Curriculum and Instruction Courses in Mathematics would you consider necessary for Mathematics Option Teachers?" 123

4.42 Teacher Responses to the Statement: "The Decision for Teachers to teach Mathematics Option should be made" 124

TABLE PAGE

4.43 Distribution of Teacher Responses to the Question of what should be the selection Procedure of Students for Mathematics Option 125

4.44 Distribution of Teacher Responses to the Question of preferred Grouping of Mathematics Option Students 126

4.45 Distribution of Teacher Responses to the Question of preferred Characteristics of Math. Option Students 126

4.46 Distribution of Teacher Responses regarding the Question of preferred Characteristics of Math. Option Students in Relation to non-Math. Option Students 127

4.47 Distribution of Teacher Responses with respect to the Question of preferred Grade Level at which Mathematics Option should be taught 128

4.48 Distribution of Teacher Responses regarding their Preference of the Type of Mathematics Option Course 129

4.49 Distribution of Teacher Respohses regarding the Extent to which students should contribute to the Selection of Curricular Content in Mathematics Option 130

4.50 Distribution of Teacher Responses to the Question on how Students should contribute to the Math. Option Curriculum 131

4.51 Distribution of Teacher Responses regarding the Amount of Overlap that should occur between the Math. Option program and the Core Math. Program 132

4.52 Distribution of Teacher Responses regarding the extent to which Resources of the Community should be used in the Mathematics Option Program 133

TABLE PAGE

4.53 Distribution of Teacher Responses to the Question of the Amount of Structure that should be imposed on the Math. Option Program by the Department of Education 134

4.54 Rank Order of Instructional Modes according to their preferred Frequency of use in Mathematics Option 136

4.55 Distribution of Teacher Responses regarding the Question of Program Length 137

5.01 Difference between the Observed Teaching Experience in Mathematics Option and the Standard for Teaching Experience at the Junior High School Level 153

5.02 Significant difference between the Observed Mathematics Background and the Standard for Mathematics Background of Mathematics Option Teachers 155

5.03 Significant difference between the Observed Background in Curriculum and Instruction Courses and the Standard for Background in Curriculum and Instruction Courses 156

5.04 Significant difference between the Observed Selection Procedures for Teachers and the Standard for Selecting Teachers to teach Mathematics Option 157

5.05 Significant difference between the Teachers' Perception of the Observed Selection Procedures for Students and the Standard for Selecting Students to take Mathematics Option ... 160

5.06 Significant difference between the Observed Grouping Practices and the Standard for Grouping Practices 162

5.07 Significant difference between the Observed Student Characteristics and the Standard for Student Characteristics . 164

TABLE PAGE

5.08 Significant difference between the Teachers' Perception of the Difference of Mathematics Option Students in Relation to Non-Mathematics Option Students and the Standard for this Difference between the two Groups 165

5.09 Significant difference between the Observed Types of Math. Option Programs and the Standard for the Type of Mathematics Option Programs 168

5.10 Significant difference between the Teachers' Perception of the Extent to which Students do and should contribute to the Selection of Curricular Content in Mathematics Option 169

5.11 Significant difference between the Teachers' Perception of how Students do and how they should help to structure the Mathematics Option Program 171

5.12 Significant difference between the Observed Content Overlap and the Standard for Content Overlap of Mathematics Option & Regular Mathematics 172

5.13 Significant difference between the Observed use of Community Resources and the Standard for using Community Resources in Mathematics Option 174

5.14 Frequency of Responses of Materials and Facilities being "Good" or "Very Good" 176

5.15 Rank Order of Instructional Activities as they were used and should be used in Mathematics Option 179

5.16 Significant differences between the Observed Length of the Mathematics Option Program and the Standard for Program Length in Mathematics Option 181

TABLE PAGE

6.01 Relationship between the Teaching Experience of Teachers at the Junior High School Level and their Level of Satisfaction in Teaching the Mathematics Option 186

6.02 Relationship between the Teaching Experience in Mathematics Option and Level of Satisfaction of Teachers in Teaching Mathematics Option 187

6.03 Relationship between the Number of Mathematics Courses and the Level of Satisfaction of Teachers in Teaching Mathematics Option 189

6.04 Relationship between the Number of Curriculum and Instruction Courses in Mathematics and the Level of Satisfaction of Teachers in Teaching Mathematics Option 190

6.05 Significant Relationship between the Mathematics Background of Teachers and their Assignment to teach the Math Option . 192

6.06 Relationship between the Teaching Experience of Teachers at the Junior High School Level and their Judgment of the Difficulty of developing a Curriculum in the Math. Option 194

6.07 Relationship between the Teaching Experience of Teachers in Mathematics Option and their Judgment of the Difficulty of developing a Curriculum in the Mathematics Option 195

6.08 Relationship between the Mathematics Background of the Teachers and their Judgment of the Difficulty of developing a Curriculum in the Mathematics Option 197

6.09 Relationship between the Curriculum and Instruction Courses Background of the Teachers and their Judgment of the Difficulty of developing a Curriculum in the Mathematics Option 198

TABLE PAGE

6.10 Relationship between the Teaching Experience of Teachers at the Junior High School Level and the Amount of Overlap of the Math Option Program Content with the Core Mathematics Program Content 200

6.11 Relationship between the Teaching Experience of Teachers in Mathematics Option and the Amount of Overlap of their Mathematics Option Program Content with the Core Mathematics Program Content 201

6.12 Relationship between the Mathematics Background of Teachers and the Amount of Overlap of their Mathematics Option Program Content with the Core Mathematics Program Content ... 203

6.13 Significant Relationship between the Number of Curriculum and Instruction Courses of Teachers in Mathematics and the Amount of Overlap of their Mathematics Option Program Content with the Core Mathematics Program Content 204

6.14 Relationship between the Teachers' Judgment of their Ability to develop a Mathematics Option Curriculum and the Amount of Structure that they wish imposed on Mathematics Option ... 206

7.01 Grade 7 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 1) 211

7.02 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME land TIME 2 (School 1) 213

TABLE PAGE

7.03 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 1) 215

7.04 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 2) 219

7.05 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 2) 220

7.06 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 3) 225

7.07 Grade 9 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 3) 226

7.08 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 3) 228

7.09 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 4) 232

7.10 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 4) 233

7.11 Grade 7 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME land TIME 2 (School 5) 239

TABLE PAGE

7.12 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 5) 240

7.13 Grade 9 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 5) 241

7.14 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 5) 243

7.15 Grade 7 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 6) 248

7.16 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 6) 249

7.17 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 6) 251

7.18 Grade 7 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 7) 257

7.19 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 7) 258

7.20 Grade 9 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 7) 259

TABLE PAGE

7.21 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 7) 261

7.22 Grade 7 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 8) 265

7.23 Grade 8 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 8) 266

7.24 Grade 9 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 8) 268

7.25 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 8) 269

7.26 Grade 7 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 9) 275

7.27 Grade 9 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 9) 276

7.28 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 9) 277

7.29 Grade 9 Mean Evaluative Score for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 10) 282

TABLE PAGE

7.30 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group and Non-Mathematics Option Group at TIME 1 and TIME 2 (School 10) 283

7.31 Grade 7 Mean Evaluative Score for Mathematics Option Group at TIME 1 and TIME 2 (School 11) 289

7.32 Grade 8 Mean Evaluative Score for Mathematics Option Group at TIME 1 and TIME 2 (School 11) 289

7.33 Grade 9 Mean Evaluative Score for Mathematics Option Group at TIME 1 and TIME 2 (School 11) 290

7.34 Mean Scores on Creativity Test in Mathematics for Mathematics Option Group at TIME 1 and TIME 2 (School 11) 290

LIST OF FIGURES

FIGURE PAGE

2.00 A Theoretical Evaluation Model 17

2.01 A Layout of Statements and Data to be collected by the Evaluator of an Educational Program 20

2.02 A Representation of the Processing of Descriptive Data 22

2.03 A Representation of the Process of Judging the Merit of An Educational Program 23

3.00 A Layout of Statements and Data to be collected by the Evaluator 42

CHAPTER I

THE PROBLEM IN PERSPECTIVE

Introduction

Educational evaluation is a complex activity involving the identification of many factors that contribute to the success or failure of a program. It is only in recent years that the approach to educational evaluation is one based on a decision-making rationale. A systematic approach is now the key to a successful evaluation. It permits the evaluators to address themselves to the basic questions of program evaluation-effectiveness of the program. In addition it aids educational decision-makers at all levels and provides a rational basis for discussion among the various interested groups.

In the present study, the use of Stake's (1967) evaluation model will enable such a systematic approach.

Background to the Problem

In 1969, the Alberta Department of Education revised the curriculum and its program of electives and implemented the B-options in the junior high schools of Alberta. Since then many questions, surrounding the B-options, have been raised. Teachers encountered difficulties understanding the nature and philosophy of the option program and indeed in implementing such a program. The program, being completely unstructured, also raised questions concerning the competency of teachers to develop curricula. The departure from the "traditional approach", in terms of content and instructional activities, raised additional questions as to the perception of and adjustment to the mathematics option program by the students.

The list of concerns is by no means complete, but it shall suffice at this point to have mentioned some.

By their very nature B-options were subject to instances of high success and failure. Questions regarding the nature and the degree of success of the B-option in mathematics form the focus of this study.

The Problem

The purpose of this study was to evaluate the mathematics B-option program in Alberta. In order to place this whole evaluation on a rational footing, it was deemed necessary to adopt or develop a model for such a task. Stake's (1967) model appeared to have the components considered relevant for this study. The variables that were considered in this study were classified into three major areas from which data and information were gathered.

Antecedents	- The mathematics option teacher
	- The mathematics option student
	- The nature of the mathematics option curriculum
	- Instructional materials and facilities
Transactions	- Instructional activities
	- Time allocation
Outcomes	- Importance of the general objectives with two objectives being measured (ie. attitudes and creativity)
	- The effect of the program on the teacher

A layout of these variables in relation to the whole evaluation model is shown in FIGURE 3.00.

A number of instruments were employed gathering data concerning the variables named above. The study and analysis of the data attempted to provide information that could be used as a basis for answering the following questions;

1. Is the professional and academic background of the mathematics option teacher related to the level of satisfaction in teaching the mathematics option?
2. Is there any relationship between the mathematics background of the mathematics option teachers and their assignment to teach the mathematics option?
3. What is the relationship between the professional and academic background and the ability to develop a curriculum in the mathematics option?
4. Is there any relationship between the professional and academic background and the amount of overlap of the mathematics option program and the core mathematics program?
5. Is the ability to develop a curriculum in mathematics option related to the amount of structure that should be imposed on the mathematics option program by the Department of Education?
6. What are the criteria in assisting teachers to teach the mathematics option?
7. What are the criteria in selecting students for the mathematics option?
8. What is the degree of involvement of students in selecting curricular content?
9. How do students help to structure the mathematics option program?

10. How do teachers judge the availability of materials and facilities for mathematics option?
11. What is the importance of the various instructional modes in the mathematics option?
12. What is the present time allotment in the mathematics option in various schools and how do teachers judge its adequacy?
13. What is the degree of importance of the stated objectives in the mathematics option program?
14. What is the effect of the mathematics option program on the teachers?
15. What is the effect of the mathematics option program on the students?
16. What is the general nature of the mathematics option curriculum?

An assessment of attitudes and mathematical creativity of mathematics option students in relation to non-mathematics option students was deemed to be important in this study. The primary purpose of this assessment was not to be viewed as a measure of the effectiveness of mathematics B-option but rather as an additional data source for describing characteristics of mathematics option students.

Specific questions that this assessment of attitudes and mathematics creativity sought to answer are:

1. Are there any differences in attitudes between the students in the mathematics option group and non-mathematics option group toward the various concepts selected at TIME 1 and TIME 2?

2. Are there any differences in creative ability in mathematics between the students in the mathematics option group and the students in the non-mathematics group?

Need for the Study

There were essentially two reasons why this evaluation was carried out:

1. There has been no comprehensive evaluation in mathematics option to date.
2. The mathematics curriculum committee of the Department of Education passed the motion to conduct a province-wide evaluation of the mathematics option program.

The investigator is aware of only one study of the mathematics option that was undertaken by Jorgensen (1973). His investigation of the mathematics option was carried out in two junior high schools in Alberta. He focussed primarily on the effects of mathematics option on attitudes and achievement.

Emard (1969) conducted a questionnaire study that evaluated student and teacher opinions on B-options in general. This study was carried out in the Pincher Creek Inspectorate only.

Gay and Chalmers (1970) conducted a pilot study in the Science B-option for the Alberta Department of Education. These results, however, were hardly an indication of the situation in Alberta and were only generalizable to the two schools involved in this pilot study.

It was the attempt of the present study to ascertain information that will enable the Department of Education to decide whether or not the program should be continued in its present structure, modified or discontinued. But if the Department of Education is to make a decision regarding the future of the mathematics B-option program, then a study of much greater scope than the previous studies is necessary.

Definition of Terms

In this study, the following definitions of terms were used:

1. Attitude: In this study attitudes are measured by means of a semantic differential attitude test involving 9 concepts and 18 scales. A group's score on the evaluative dimension within an attitude structure will be taken as an indication of that group's attitude toward the concepts.
2. B-option: A subject in the academic electives. These courses are completely unstructured in that no course outlines are provided. Examples are: Language Arts, Mathematics, Languages, Science, Physical Education and Health, and Social Studies. (Province of Alberta, Junior-Senior High School Handbood, p. 7)
3. Concept: It will pertain to the objects of judgment used in the semantic differential. The concepts to be used in this study will consist of nouns and phrases relevant to mathematics.
4. Non-Mathematics Option Group (NMO): Students who are enrolled in the core mathematics program only.
5. Core Subjects: Courses that are taken on a compulsory basis by all junior high school students in Alberta. Examples are: Language Arts, Social Studies, Mathematics, Science, and Physical Education and Health (Province of Alberta, Junior-Senior High School Handbook, p. 5)

6. Creative Ability in Mathematics: The use of Buckeye's (1970) Test of Creative Ability in Mathematics consists of six divergent thinking items and is scored for fluency only. It is recognized that creativity is a complex group of abilities, but for the purpose of this study it will mean the fluency with which students can produce solutions to mathematical problems.
7. Department of Education: The Department of Education of the Government of the Province of Alberta.
8. Evaluation: It is the process by which information is systematically collected and processed for the purpose of decision-making. (Rhodes and Lomas, p. 3)
9. Mathematics Option Group: Students who are enrolled in the core mathematics program as well as in the mathematics option program.
10. Junior High School: A school accommodating grades seven, eight and nine.
11. Mathematics B-option: An unstructured elective offered under B-options in Alberta.
12. Core Mathematics: A compulsory course offered as a core subject.
13. Scale: It will refer to a pair of bipolar adjectives separated by five divisions. For example:

    good _____:_____:_____:_____:_____ bad.

14. Congruence Analysis: It may be descriptive, statistical, or both in nature and it is used to investigate discrepancies between intents and observations and observations and standards.

15. Contingency Analysis: It may be descriptive, statistical, or both in nature and is used to investigate the logical or empirical relationship of two or more variables.
16. Absolute Standards: These provide a base for measuring observations against and in this study they are an indication of the degree of excellence which was arbitrarily set by the investigator and the mathematics option teachers.
17. Relative Standards: These provide a base for measuring observations against and in this study the investigator used the characteristics and performance levels of the non-mathematics option groups.

Setting of the Study

This study was carried out during the period of February 1, 1974 to May 31, 1974.

Two major sources were used to gather information. One source was the population of mathematics option teachers of Alberta from which 200 teachers had been selected at random. The second source, for the purpose of data gathering, were those junior high schools of Alberta that offered a mathematics option program.

The eleven schools that participated in this study were selected from nine school systems throughout Alberta.

The samples and selection procedures are described in Chapter III. See also Appendix A of this thesis for a summary of the participating schools and school systems.

Evaluation Procedure

An application of Stake's (1967) evaluation model to the present study necessitated the use of various techniques.

The "intents" column of the matrix was completed by recording the statements of intent made by the Department of Education prior to and during 1969 when the mathematics option program was implemented in Alberta.

The "observations" column of the matrix consists of information obtained through the mathematics option teacher questionnaire, student questionnaire, teacher interviews, student attitude test and student creativity test.

The "standards" column consists of expectations as expressed by the mathematics option teachers on the questionnaire and by the investigator. The performances of the non-mathematics option group on the attitude test and creativity test were used as standards for behavioral outcomes for the mathematics option group.

The judgments that were rendered were made by the investigator.

Delimitations of the Study

1. The study was delimited to the information that could be obtained through the five instruments.
2. The study was delimited to include 11 schools in which student-testing was carried out.
3. The study was delimited to the nine variables in FIGURE 3.00, page 42.
4. The study was delimited to a random sample of 200 mathematics option teachers for the purpose of responding to the MOTQ.
5. The evaluation period, for assessing the development of attitudes and mathematical creativity was delimited to four months rather than a whole year.

Outline of the Report

This thesis is comprised of eight chapters. Chapter I provides an introduction to the problem and the setting of the evaluation procedure. Chapter II discusses the background to the study and in particular deals with the theories of evaluation of Scriven, Stufflebeam, Taylor and Maguire, and Stake. The remaining sections of this chapter include some views on program evaluation, attitudes and mathematics, creativity and mathematics, and the theoretical framework of the present study. Chapter III describes the design and evaluation procedure and in particular views the present study in terms of Stake's evaluation model. Included in this chapter are also the educational questions and null hypothesis, a description of the instruments, and the statistical analysis being used. Chapter IV includes the rationale of the Alberta Junior High School program, the intents of the mathematics B-option program in Alberta, and the observations and standards with regard to the variables being studied. The congruence of observations with intents and observations with standard is discussed in Chapter V. The results of the contingency analysis are presented in Chapter VI. The content of Chapter VII deals with the results by school. In particular it presents the results from the teacher interview and the attitude and creativity test administered to students. The last chapter presents the judgment and summary of conclusions and recommendations.

CHAPTER II

BACKGROUND TO THE STUDY

This chapter is divided into three sections. The first section, entitled "Theories of evaluation", reviews evaluation models and their underlying theories of Scriven, Stufflebeam, Taylor and Maguire, and Stake. It also discusses some views on program evaluation. The second section, entitled "Measurement of Outcomes", is devoted to the review of the literature pertaining to (1) attitudes and mathematics and (2) creativity and mathematics. The last section focuses on the theoretical framework of the present study. In particular, it outlines the application of Stake's model to the present study and at the same time highlights the modifications of this model to suit the purpose of this study.

Theories of Evaluation

Scriven's theory of evaluation

The publication of Scriven's (1967) "Methodology of Evaluation" provided educators and evaluators with a broad conceptualization of an evaluation methodology. In his paper, he took first issue with a number of terms that caused a great deal of confusion among evaluators. He pointed out an important distinction between the roles and goals of evaluation. The role of evaluation may be enormously various; it may be part of a curriculum development activity, decision-making acticity or an activity related to course improvement. However, the goals of an evaluation are always the same - to determine the worth, value or merit of some educational activity.

The terms formative and summative evaluation were another much needed clarification between two distinct roles of evaluation. By formative evaluation, Scriven means the evaluation of a course in a state of development. Summative evaluation refers to the assessment of courses or curricula ready to be used. In Scriven's words, "... formative evaluation is part of a rational approach to producing good results on the summative evaluation ... (p. 44)."

Now, having reduced some of the semantic confusion, the theory of Scriven can be described as follows. Scriven basically distinguishes between two approaches in evaluation. The first approach is termed "instrumental evaluation" and it concerns itself primarily with an appraisal of the instrument itself. In a particular instance this would involve evaluation of content, goals, grading procedures, and teacher attitudes.

The second approach he terms "consequential evaluation". This approach requires an assessment of the effects of the teaching instrument on the pupils. It often involves an appraisal of differences between experimental groups and control groups between pretest and post-test results. The important aspect of this approach is to find out how well a student performs at the termination of a course. Scriven does not subscribe to consequential evaluation by itself, because he feels that an evaluation must give some consideration to instrumental as well as consequential criteria. He said:

> If we have really satisfied ourselves that we are using good test of the main criterion variable, then to discover parity of performance is to have discovered something extremely informative. "No difference" is not "no knowledge" (p. 67, 1967).

What, in effect, Scriven is suggesting is a compromise between instrumental and consequential evaluation. This type of evaluation focuses primarily on goal-formulation. Scriven does not demand that there be total commitment to these goals, but rather suggests that these goals "be regularly re-examined and modified in the light of divergences from them that have arisen during the developmental activities, where it is felt that these changes have led to other, more valuable goals (p. 56)."

As the evaluation project develops, the construction of a test-question pool should be begun. The questions in this pool should be written in the operational version of the goals. Re-examining of goals and scrutinizing the test-questions should occur at the same time so that a possible change of goals may lead to a more meaningful change of test-questions.

A final task for an evaluator in this model is to secure "external judgments as to the cohesiveness of the alleged goals, the actual content and the test-question pool (p. 57)."

Basically, the procedure outlined above constitutes a method that, according to Scriven, will establish the effectiveness of a program. He adds, however, that additional refinements would be desirable and often necessary. These refinements involve the determination of the degree of matching between: (1) goals and course content, (2) goals and examination content, and (3) course content and examination content.

Stufflebeam's Theory of Evaluation

Stufflebeam's theory of evaluation is probably best described by examining his evaluation model (1967). This model, often referred to as CIPP, views evaluation in four stages. The first stage, Context

Evaluation, is the most basic type and its main purpose is to provide a rationale for determination of objectives. In particular, "it defines the relevant environment, describes the desired and actual conditions pertaining to that environment, identifies unmet needs and unused opportunities and it diagnoses the problems that prevent needs from being met and opportunities from being used (1971, p. 218)."

Context evaluation is systematic and employs two modes of evaluation - contingency and congruence. Using the "contingency mode", evaluators often search outside the system in order to promote improvement within the system.

The "congruence mode" of context evaluation compares actual and intended system performance. It determines whether or not goals are being achieved as intended.

The second stage, Input Evaluation, involves the evaluator in assessing system capabilities, available input strategies, and designs for implementing the strategies. The main function of input evaluation is to determine how best to meet newly stated objectives. Decisions based on input evaluation usually result in specifying procedures, materials, facilities, equipment, schedules, organizational schemes, staff requirements, and budget requirements.

The third stage, Process Evaluation, has three main objectives, (1) to detect or predict defects in the procedural design or its implementation, (2) to provide information for programmed decisions, and (3) to maintain a record of the procedure as it occurs.

The adequacy of context and input evaluation determine the extent to which process evaluation can be performed. Process evaluation is needed to interpret the outcomes and thus serves an extremely important function.

At the fourth stage, Product Evaluation, the evaluator investigates the extent to which objectives have been attained. This, of course, requires a number of intermediate steps. First, the evaluator must devise operational definitions of objectives, then he must determine measuring criteria associated with the objectives, thirdly he compares the measurements with predetermined absolute or relative standards, and finally he relates the outcomes to context, input, and process information.

All four stages in this evaluation model are related to a decision-making process. Context evaluation seeks decisions related to the setting to be served and goals to be attained. Input evaluation is used to decide if outside assistance is required, how the objectives should be stated operationally, what strategies to be used for problem solution, and what procedural design should be employed. Process evaluation is useful for implementing the program and providing feedback so that refining of the program is possible. Product evaluation is necessary to decide whether the program should be continued, modified, or discontinued.

Taylor and Maguire's Theory of Evaluation

The evaluation model proposed by Taylor and Maguire (1966) provided a framework for evaluation which was based on a four stage conception of curriculum development. They suggested that the formulation of broad objectives was due to societal pressures. These broad objectives define the relationship between school and society. Of course, statements of broad objectives are often of little value since they do not specify behavior in operational terms. Curriculum developers (1) translate the

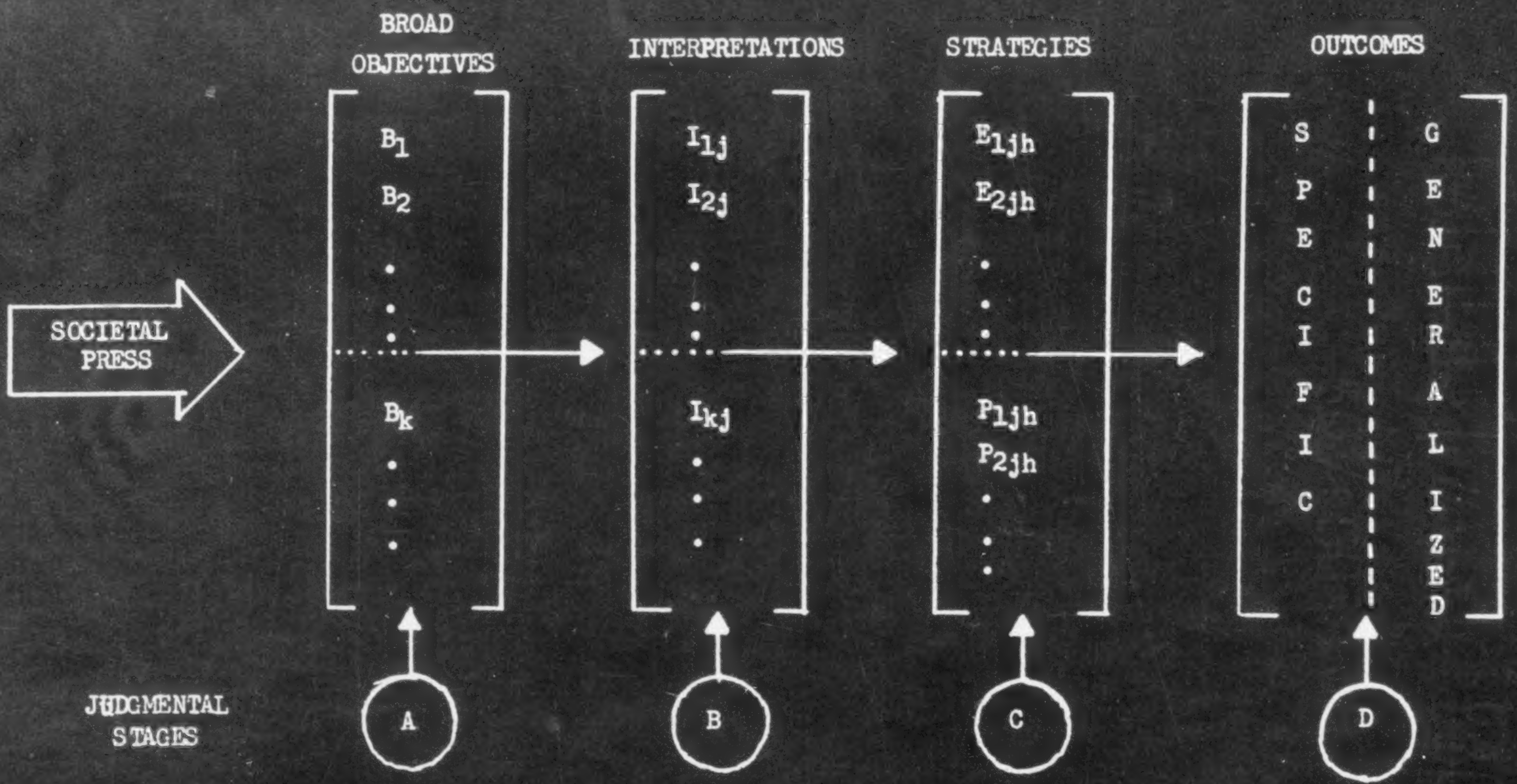
BROAD OBJECTIVES
INTERPRETATIONS
STRATEGIES
OUTCOMES
SOCIETAL PRESS
B_1
B_2
B_k
I_{1j}
I_{2j}
I_{kj}
E_{1jh}
E_{2jh}
P_{1jh}
P_{2jh}
SPECIFIC
GENERALIZED
JUDGMENTAL STAGES
A
B
C
D

FIGURE 2.00: A Theoretical evaluation model. (Taylor and Maguire, 1966, p. 13).

broad objectives into specific behavioral objectives and then develop classroom strategies (2) to attain them. The students (3) interact with the strategies to produce observable behaviors.

The evaluation model views evaluation as two activities: measuring and assessing value. Measurement data consist of description of goals, environment, personnel, methods and content, and immediate and long-range outcomes as well as the determination of the relationship among them. Assessing value includes the collection of personal judgments of the quality and appropriateness of goals, inputs, and outcomes. At each stage in the model and between the stages (See FIGURE 2.00, p. 17) the descriptions and judgments are compared to produce information regarding the strengths and weaknesses of the curriculum.

In summary, the Taylor and Maguire model is a linear model with societal press as the origin of objectives and criterion behavior as the outcome. They suggested that the origin of objectives should be the values of society and not just a selected group of educators. It is, perhaps, for this reason that the inclusion of value assessments at various points in the evaluation process was considered an important feature of their model.

Stakes's Theory of Evaluation

Stake (1967) maintains that evaluation in the past has not been broad enough in that evaluators have not provided full description and full judgment which he believes, are essential to evaluation of any educational program.

Perhaps it was this concern that resulted in a model that provided a method of collecting and examining data for meaningful evaluation.

Stake's (1967) evaluation model has a number of components and he identified three main areas of information from which data must be gathered. "Antecedent data" describe the conditions prior to teaching and learning and may in some way relate to outcomes. They may include students' aptitude, previous experience and interest. "Transaction data" are dynamic in nature and they include the countless encounters of students and their environment. The third area was described by Stake as "Outcome data". These were to include the students' ability, attitude and asperations resulting from their experience in the program. Outcomes can also include information such as the effect of the program on the teacher, wear and tear of equipment and the cost incurred by the program.

The data collected during the evaluative process fall in either one of two major categories: descriptive data or judgmental data. These in turn, are grouped into four classes: (1) intents, (2) observations, (3) standards, and (4) judgments. (See FIGURE 2.01, p. 20).

Intents: These are the "goals" and "objectives" that encompass the educational environment, subject matter, the planned-for demonstrations, and the intended student behavior.

Observations: The collection of data in this section focuses particularly on areas that contribute to a better understanding of the educational program. The use of inventory checklist, interviews, checklists, opinionnaires, and all kinds of psychometric tests is predominant in obtaining observational data.

Standards: These are measurements of excellence and Stake believes that these should be stated explicitly rather than inplicitly. It is, how-

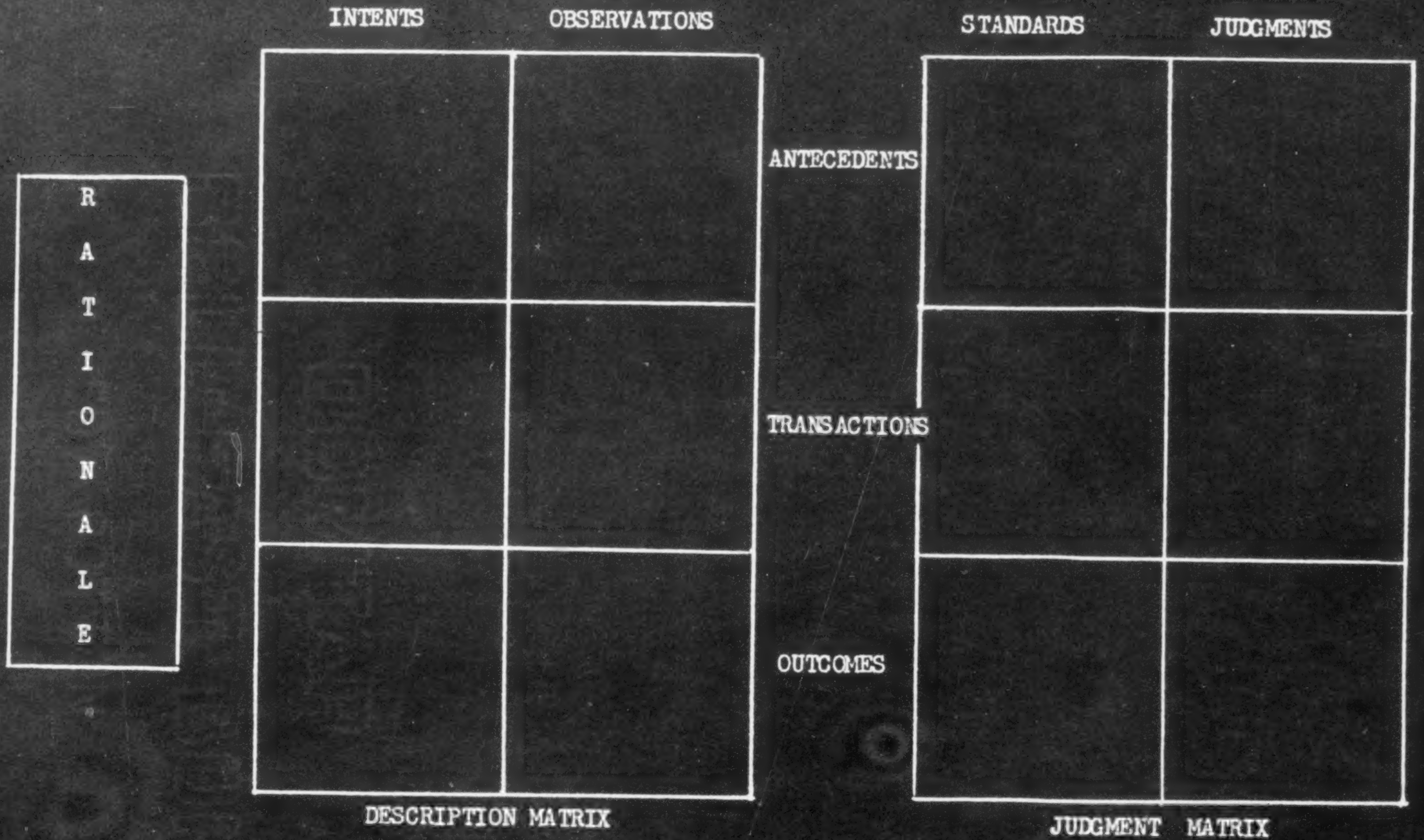
INTENTS
OBSERVATIONS
STANDARDS
JUDGMENTS
RATIONALE
ANTECEDENTS
TRANSACTIONS
OUTCOMES
DESCRIPTION MATRIX
JUDGMENT MATRIX

FIGURE 2.01: A layout of statements and data to be collected by the evaluator of an educational program (Stake, 1967, p. 529).

ever the responsibility of the evaluator to make known whose standards have been used.

Judgments: These provide an overall estimate or rating of worth and merit of the evaluated program. Judgments are essential in the decision-making process and should not be absent from an evaluation. Stake distinguishes two bases for judging a program: absolute standards as reflected by personal judgments and relative standards as reflected by an alternate program. The intended use of the information should be the guide as to which kind of judgment is to be made.

For the analysis of descriptive data, Stake suggested two methods. The evaluator may first examine the contingency among antecedents, transactions, and outcomes and second he may observe the congruence between intents and observations. (See FIGURE 2.02, p. 22). Examination of contingencies requires the evaluator to provide logical and empirical evidence of relationships between the antecedent conditions, transactions, and outcomes. In the case of congruence, the evaluator is primarily interested in showing that which was intended did actually occur.

As was mentioned above, Stake suggested two bases when judging a program. Judging with respect to an absolute standard implies judging against a theoretical criterion of excellance. A comparison of the results of two sets of descriptive data would be judging with respect to a relative standard. Both methods of judgment require the evaluator to determine whether or not each standard was met. (See FIGURE 2.03, p. 23).

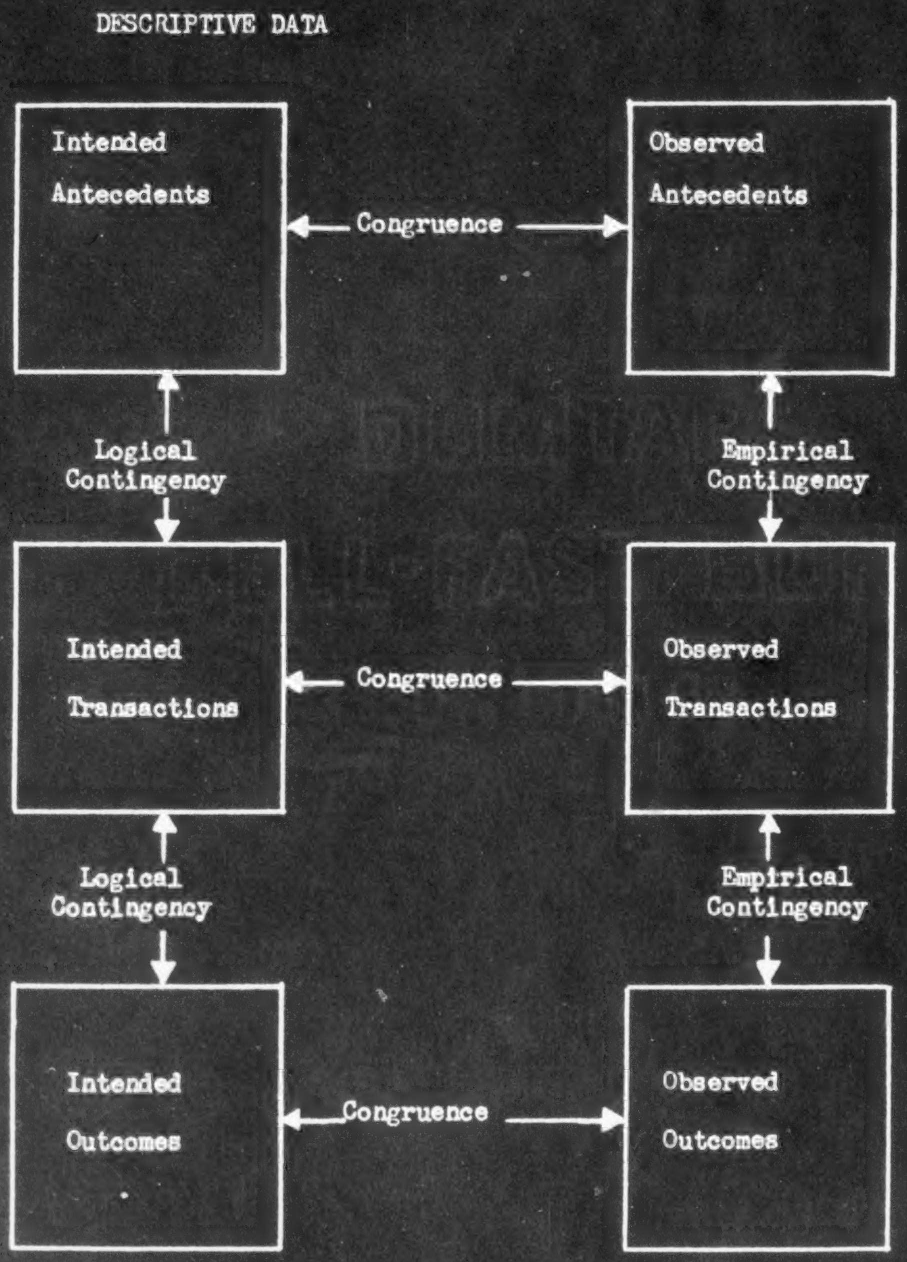
DESCRIPTIVE DATA
Intended Antecedents
Congruence
Observed Antecedents
Logical Contingency
Empirical Contingency
Intended Transactions
Congruence
Observed Transactions
Logical Contingency
Empirical Contingency
Intended Outcomes
Congruence
Observed Outcomes

FIGURE 2.02: A representation of the processing of descriptive data (Stake, 1967, p. 532).

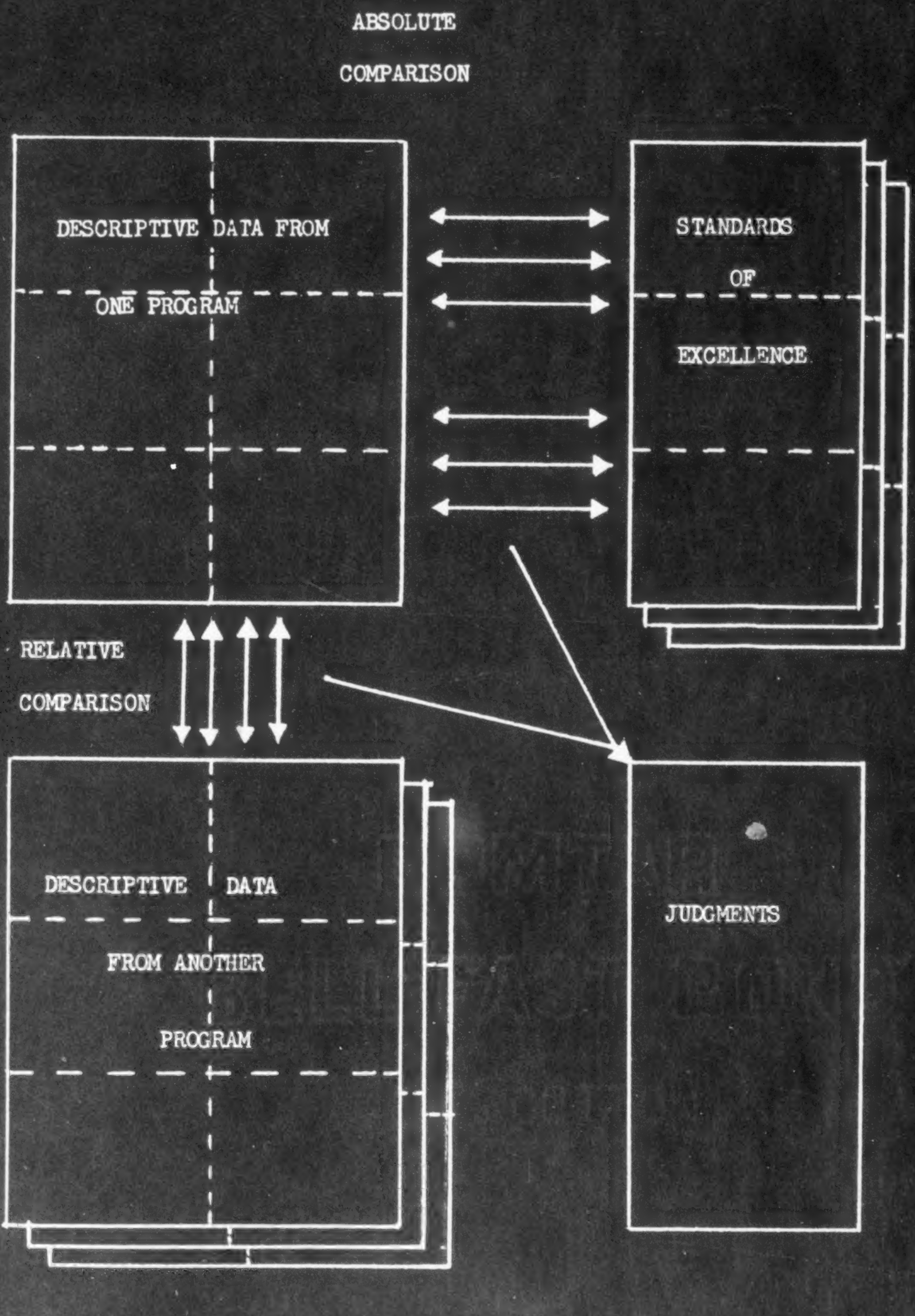
ABSOLUTE
COMPARISON
DESCRIPTIVE DATA FROM
ONE PROGRAM
STANDARDS
OF
EXCELLENCE
RELATIVE
COMPARISON
DESCRIPTIVE DATA
FROM ANOTHER
PROGRAM
JUDGMENTS

FIGURE 2.03: A representation of the process of judging the merit of an educational program (Stake, 1967, p. 537)

Some Views On Program Evaluation

Educational evaluation has gone through many phases. The models and theories that have been discussed previously are only a few examples of the recent trend in curriculum evaluation.

Cronbach's (1963) paper, "Course Improvement through Evaluation" has often been credited with being the first paper in an era of new evaluation methodologies. Until that time, evaluation was viewed as synonymous with various testing techniques.

The basic notion of Cronbach's paper was expressed in the suggestion to use unmatched experimental designs for gathering information on the educational achievement of groups. Unlike previous notions, he argued that if evaluation was concerned with course improvement, then a comparison of one course with another should not dominate the evaluation plan. He further suggested that "...evaluation should be used to understand how the course produces its effects and what parameters influence its effectiveness (p. 675)." This suggestion was later to become an important consideration in many theories and models (Scriven (1967), Stake (1967)). Evaluation was seen by Cronbach as a decision-making process resulting in three different types of decisions. The first is Course Improvement, which decides whether or not instructional materials and methods are satisfactory or need change. The second type is a Decision about Individuals, identifying the needs of pupils for the sake of planning instruction, judging pupil merit and acquaint the pupil with his own progress. The third type is an Administrative Decision that involves the judging of how good the school system is and the effectiveness of the teachers.

Cronbach also raised questions regarding process and product evaluation and the need to state desired outcomes. These issues, however, were treated in more detail and specificity by later writers, such as Scriven (1967), Stufflebeam (1966, 1967) and Stake (1967).

Scriven took issue with Cronbach on the role of comparative studies. While Scriven agreed that comparative studies are often equivocal or else do not give any understanding of why observed differences exist, he suggested that comparative evaluations are often easier than absolute evaluations, and the results of a comparative study are useful at various times in the development of a curriculum to provide information needed to decide whether to continue with development or discontinue the program.

On the issue of the relative importance of summative and formative evaluation, it is obvious that Cronbach considered formative evaluation to be of greatest importance. He stated: "The greatest service evaluation can perform is to identify aspects of the course where revision is desirable (p. 675)." Again, Scriven would disagree in that he believes evaluation should involve an examination of the instruments as well as outcomes. Also Stufflebeam (1966) theorized that evaluation was carried out in two different stages which he called "product evaluation and process evaluation." Product evaluation related outcomes to goals on the basis of specified criteria. Process evaluation related procedures to outcomes and at the same time provided useful data for decision-making.

Hastings (1966) believed that evaluation was not equivalent to giving, scoring and interpreting tests in normative terms. Evaluation should search for differences among methods of instruction and then view the performance of the students in the light of the differences among instructional methods. He objected to the exessive emphasis placed upon ascertaining the extent to which students' test performance is congruent to the program's objectives. He felt that evaluation should rather focus on the "Whys of the Outcomes." Hastings concluded that the main function of evaluation was (1) to collect information that can be used as feedback to the innovators for further revision of materials and methods, and (2) to provide information as input for decision-making by the schools about adoption of course-content-improvement packages.

Stake's (1967) revision of Scriven and Hastings resulted in a model that permits an accurate examination of all variables and their relationship. Like Hastings' model, the stress was placed on the "Whys" of the outcomes. The relationship among the antecedents, transactions, and outcomes was to provide the necessary insight into the total educational process.

In summary, it appears that there are many commonalities in the views expressed. "Do the actual learning experiences produce the desired results?" or "What are the strengths and weaknesses of the program?", and "How effective is the program and the instruments used in the program?" are only a few common concerns that were detected.

MEASUREMENT OF OUTCOMES

The possible outcomes of a program, that could be measured, are too numerous to be included in any single study. The choice as to what outcomes the investigator wishes to focus upon should not be an entirely arbitrary decision. In the case of the present study there were a number of considerations made that led to the inclusion of attitudes and creativity as possible outcomes. First, it is believed that the success of any program rests to a great extent on student attitudes and second, that adherence to the guidelines of the program has the potential of being conducive to the development of positive attitudes and creativity.

Attitudes and Mathematics

There is an ever growing concern among educators about the attitudes of students toward programs. Neale (1969), in his paper on "The Role of Attitudes in Learning Mathematics", points out that attitudes play a crucial role in learning mathematics and that the development of attitudes should become an important objective of instruction. Positive attitudes toward mathematics have a direct relationship on the students' learning of mathematics.

In an attempt to explain the causes of positive and negative attitudes, researchers found, among other factors, that the nature of the program and the modes of instruction were often responsible for the development of attitudes. This assertion was also supported by Shaw and Wright (1967) in that they suggested that the development of positive attitudes toward mathematics is a function of the mathematics program and the way in which it is taught.

A number of studies have been conducted that seem to indicate that the modification of a program and the application of a different teaching method can result in a change of attitudes. The study by Vance (1969) using grade 7 and grade 8 students, concluded that the mathematics laboratory group and the class discovery group benefited mathematically more than the control group. The measures on attitude favored the mathematics laboratory group which was followed by the class discovery group. It is, perhaps, important to mention that the students in the mathematics laboratory group considered the opportunity to work independently of the teacher the most popular feature of this instructional mode. Also, compared to the other groups they had a higher rating in feeling that learning mathematics is fun and enjoyable.

The study on student attitudes, reported by Maguire (1970) in the "Individually Prescribed Instruction (I.P.I.) Project Report", utilized a number of instruments comparing I.P.I. students and students in a control group. The questionnaire results indicated that the I.P.I. group had a more positive attitude toward arithmetic than the control group. This was also borne out by the semantic differential attitude test. In general, the concepts that involved school experiences that were different for the two groups did produce significant results with the I.P.I. group exhibiting some positive responses. At one point, Maguire stated that "...the data suggest that the I.P.I. program may have arrested the trend that seems to occur for students to dislike mathematics (p. 232)." This statement probably applies equally well to the science option program in the schools which were investigated by Gay and Chalmers (1970). They found that students enrolled in the science option program developed more positive attitudes toward science at the junior high school level. Jorgensen (1973), in his study on the Mathematics B-option, could not fully support this statement. He found that students enrolled in mathematics B-option had generally more negative attitudes toward the concepts on the semantic differential test. On the concept "Education" he found significant differences (at the .05 level) in favor of the students who were not enrolled in mathematics option.

Ebeid (1964) conducted an experimental study with grade seven and eight students from the University High School at the University of Michigan. He investigated two teaching approaches - (1) an unstructured self-selected activity approach using a variety of mathematics materials and (2) a conventional approach, dominated by a textbook and group instruction.

The experimental group used the first approach with one period per week for self-selected activities in the first semester and two periods per week in the second semester.

The control group was exposed to the second approach in all periods using school mathematics study group textbooks only.

Ebeid found no significant differences between the two groups in attitude toward mathematics but reported the average on the attitude test increased for the experimental group while it decreased for the control group throughout the year. He also stated that although the experimental students realized an increase in knowledge they stressed the psychological contributions of the self-selected activity approach considerably more. This was done by frequently expressing an appreciation of the opportunity to work independently at their own level, rate, and ability. He concluded that students and teachers were satisfied with the self-selected activity approach on the whole but recommended more refinement in the self-selection materials.

From the results of this study, Ebeid concluded that it is possible to modify the mathematics program to a more flexible one where the students, of different levels of ability, as individuals can have a chance to self-select from more of an intellectually stimulating range of mathematical materials to restore the balance between their group's norms and their unique standards and between the system requirements and the individual's own interest.

The relationship between grade level and attitude has been confirmed by many studies. Researchers have consistantly demonstrated a decline of positive attitudes as students progress through the years of schooling. Neale (1969) observed that "students develop an increasingly unfavorable attitude toward mathematics as they go through school (p. 634)." He further mentioned that over a period of six years the mean score had declined a full standard deviation. An earlier study by Neale and Proshek (1967) indicated that among 350 children in the fourth, fifth, and sixth grades, the evaluative scores became significantly less positive toward school-related concepts as the grade in school increased. Yamamoto, Thomas, and Karns (1969) conducted a fairly comprehensive study involving 1600 grade six through nine students. The attitudes were tested on people concepts (class-mates, parent, teacher, and myself) and on curriculum concepts (social studies, language, science, and mathematics). They reported like previous studies, that attitude ratings decreased as the grade level increased. The Dutton and Blum (1968) study produced a number of conclusions, one of which was that "...younger children have more positive attitudes toward the new mathematics than older children do (p. 263)."

The age or grade at which a decrease of attitude occurs has also been of considerable interest to educators and reasearchers alike. Dutton (1956) found that long-lasting attitudes develop at each grade level, grade five and seven seemed most crucial. Changes in attitude seem to occur during one or two years of junior high school for about one-third of the students (p. 22). Dutton (1968) repeated his study of 1956 using the same junior high school. His intent was to study attitude changes and to find out how students felt toward the "new" mathematics. Although the changes of attitude were in favor of the new mathematics program, but again he confirmed earlier reports that attitude changes are most crucial between grades four and seven (p. 267-68). Similar results were borne out in Callahan's (1971) study on "Adolescent Attitudes toward Mathematics". He stated that lasting attitudes toward mathematics developed at each grade level, with grade six and seven being the most important grades for developing attitudes.

The review of some of the literature related to attitude revealed two important points. Attitude formation toward mathematics is to a great extent a function of the mathematics program and the way in which it is taught. The review also produced evidence that lasting effects on attitude are developed at each grade level with grades five to seven being the most crucial.

Creativity and Mathematics

In this section the focus is primarily on creativity and instruction.

There are still many avenues in the area of creativity that remain unexplored and will remain so for some time to come. This, in part, is due to our lack of understanding the nature of a creative person and the inability to define creativity operationally. Many studies have been conducted in the past attempting to investigate the nature of creativity and characteristics of creative persons. These studies are essential if instructional methods are to be developed that promote creative thinking. MacKinnon (1963) suggests that:

> Our task as educators is not to recognize creative talent after it has come to expression, but either through our insight or through the use of validated predictors to discover talent when it is still potential and to provide that kind of educational climate and environment which will facilitate its development and expression (p. 166).

The kind of educational environment that is conducive to creative thinking is still a much disputed area of research. McGannon (1972) pointed out that "... no one knows precisely how to organize experiences that will foster creativity (p. 8)." He believed, however, that redesigning mathematics textbooks so as to include real problems rather than paradigms would be a step in the right direction. That a change in the mathematics curriculum can result in improving logical reasoning and creative thinking was reported by Moore and Cain (1968). Their study involved one teacher and two classes of first year high school algebra. Pre- and post-test scores were obtained on selected logical reasoning and creativity tests in Guilford's battery. Significant changes were observed between the pre-course and post-course scores that suggested that

"...within the new mathematics curriculum are educational experiences which may foster development of logical reasoning and creative thinking abilities (p. 733)." This is not to mean that program modification alone will produce more creative students. It is strongly believed that the teacher is the key to creative thinking in the classroom. Of course, this premise is based on the assumption that creative productivity is learned behavior which can be developed through appropriate instructional methods. Guilford (1962) supported this assumption when he claimed that creativity is a property that is shared by all of humanity to a greater or lesser degree. If the above assumption and Guilford's statement can be accepted, then the role of the teacher, as a developer of creative thinking ability, becomes even more important.

That creative productivity can be developed through particular instructional modes was demonstrated in an extensive study by Parnes and Meadow (1959, 1961), on the possible usefulness of brainstorming for problem solving. Their findings suggested that (1) training in brainstorming increased creative problem solving, (2) brainstorming produced more problem solutions than did methods which penalize bad ideas in some way, (3) brainstorming produced more good ideas than did conventional methods, (4) extended effort to produce ideas lead to an increased number of good ideas, and (5) students exposed to brainstorming obtained higher scores on Guilford's tests of creative abilities than did students who were not exposed to brainstorming.

A number of studies in the area of creativity and instruction have often resulted in lists of activities or other guidelines for teachers. Torrance et al (1963) provided guidelines for the development and expression of creative ability to occur. They suggested (1) treat questions with respect, (2) treat imaginative, unusual ideas with respect, (3) show pupils that their ideas have value, (4) give opportunities for practice or experimentation without evaluation, (5) encourage and evaluate self-initiated learning and (6) tie in evaluation with causes and consequences.

Johnson and Rising (1967) have argued that classrooms that offer little opportunity for student participation repress creativity, whereas classrooms that provide for student participation and that encourage original ideas and approaches foster creativity. In an effort to be of some assistance to teachers they offered the following suggestions.

1. The students are actively participating in discovering concepts through reflective thinking, problem solving, experimentation, analysis, or generalization.
2. The students are encouraged to ask questions, correct errors, propose new solutions or proofs, and introduce concepts that are different from those of the text or class discussion.
3. The students are required to give reasons for answers, statements, methods, rules, so that they will know the "why" as well as the "how" of what they do.
4. The teacher is prepared with reading material, applications, illustrations, procedures, and problems that enhance and extend the meaning of a concept.
5. The students are encouraged to explore topics independently.
6. The students are given open-research projects, reports, creative writing, and supplementary assignments.
7. The tests used include open-book tests, reading tests, performance tests, or reasoning tests that measure productive thinking.

8. The teacher shows enthusiasm for and enjoyment of his work and his pupils and appreciation for new ideas.
(1967, p. 138)

Aiken (1973) in his review of the literature on "Ability and Creativity in Mathematics" summarized the most recent views on creativity and instruction. He concluded that (1) encouraging questions, verbalization, and hypothesis thinking; (2) constructing models and using heuristics; (3) stress relationships; (4) shifting attention to break up incorrect mental sets; and (5) being patient and friendly are the most important aspects of a creative teaching approach.

The emphasis in this section was placed upon teaching mathematics creatively and on the educational environment that should be provided by the teacher. In general there seems to be agreement on DeCecco's (1968) statement that "the teacher can provide certain conditions which will increase the flexibility, fluency, and originality of the student's solutions to various problems (p. 459)."

Theoretical Framework of the Present Study

Many unanticipated problems in an evaluation can be overcome by developing a theoretical framework. This provides a way of organizing one's thinking about the important aspects of an evaluation. It also permits one to see the entire complex of decisions and it assures that all important variables and relationships have been considered.

In order to place the present study in theoretical perspective, it was considered necessary to review some of the current theories and models in curriculum evaluation. Special emphasis was placed on Stake's (1967) model because it provided the underlying framework for the present study (See FIGURE 2.01, p. 20). The discussion of the evaluation models and the views on program evaluation revealed a number of important observations. In all cases the role of objectives was prominent. It was also observed that the differences among the various models and evaluators were primarily those of emphasis, terminology, and evaluation procedure. The evaluation model developed by Stake appears to subsume the models developed by the other writers reviewed.

There is substantial agreement between Stake's model and Scriven's mediated evaluation method with only this difference, that Stake has provided a method of collecting and examining empirical data for an accurate data analysis while it is impossible in Scriven's method.

Considerable agreement was also found between Stake and Stufflebeam. But again, Stake saw a need for more detail in order to make it workable. There is the danger that the administrative model of Stufflebeam is too closely tied to the collection of information for particular decisions at the expense of limited empirical investigations. Stake attempted to overcome this danger by establishing a broader base for an evaluation methodology.

The commonalities of the model developed by Taylor and Maguire and the model developed by Stake are simply compelling. Taylor and Maguire, like Stake, view evaluation as consisting of two activities: measuring and assessing values. Measuring is equivalent to Stake's description and assessing values encompasses judgments. Although value assessment at various points in the evaluation process was not explicitly stated by Stake, it is certainly an implicit component of his judgment matrix. Another dimension of Stake's model is the classification of data into antecedents, transactions and outcomes. The occurrence of this dimension in the Taylor and Maguire model is emphasized to a much lesser degree. The major shortcoming of the Taylor and Maguire model is seen to be as not having a sufficiently broad conceptualization of a methodology of evaluation.

From all the models examined, it appears that only Stake's (1967) model provides a method of collecting and examing the empirical data for an accurate evaluation. It is for this reason that Stake's model is used as a basis. The work and ideas of other methodologists is incorporated as needed.

The use of Stake's (1967) model in the present evaluation was thought to be appropriate in that it provided a broad framework within which the variables and their relationships could be studied. A number of circumstances necessitated some modifications of Stake's model which are discussed below. (See FIGURE 2.01, p. 20, as reference for this discussion).

A list of intents was prepared from statements made by the

Department of Education prior to and during 1969. Only intents with respect to the variables under consideration were stated and classified as to whether they were antecedents, transactions, or outcomes.

The second column of the matrix focused on observations and the investigator tried to describe what actually occured. This activity is normally guided by the statements of the intents column, but an attempt was made to go beyond the statements of intention and pick up any unanticipated effects. Nine variables were of interest in this study and it required the use of five instruments in order to describe the observations on these variables.

The first column of the judgment matrix deals with the standards. In most situations there do not exist standards and it is then the evaluator who must collect an appropriate set. The determination of standards is a most contentious issue in an evaluation. In order to somewhat overcome this problem in the present study it was decided to involve the teachers who teach the mathematics option. On one of the instruments, the Mathematics Option Teacher Questionnaire, the teachers responded to most questions twice. One question asked "What is" and the other question asked "What should be". The "What should be" responses were then used as standards of excellence. The sections on "Materials and Facilities" and "The effect of the program on the Teacher" were the only exceptions. Here, the investigator set arbitrary criteria for standards (See CHAPTER III for more detail).

The performance of mathematics option students on an attitude test and creativity test was also of interest in this study. In order to judge the students' performance, the investigator decided to use the performance of the non-mathematics option students as standards of excellence.

The determination of standards, as it was done in the present study, was seen as a viable alternative to Stake's suggestion of using a representative group of experts who are external to the evaluation.

Once the evaluation has reached the stage of having completed the first three columns, the final task is to pass judgment. The purpose of judgment is to determine the congruence of the observations with the intents, and standards, to establish the logical and empirical contingencies to determine the importance of various standards, and to provide a complete evaluation picture taking all measures into account.

Stake's model permits some flexibility as to the completeness of judgment. For example, the evaluator may just wish to pass judgment with respect to congruence or he may only want to concern himself about the contingency establishment. This investigator took advantage of this flexibility and decided to reduce somewhat the comprehensiveness of the judgment. Judgment, as seen in the present study, was to determine the congruence of the observations with the intents and standards, establish empirical contingencies, and provide a complete evaluation picture on the basis of the analyses and in the light of the given data.

The task of judging should ideally be done by a committee, including members of the Department of Education, teachers, school board members, students, and parents. This being not feasible, it was decided that the evaluator do the judging.

SUMMARY

The theories of evaluation of Scriven, Stufflebeam, Taylor and Maguire, and Stake were outlined here with special emphasis on Stake's evaluation model. Also some other current views on curriculum evaluation were presented.

The section on "Measurement of Outcomes" focused on attitudes and creativity as they relate to mathematics because both were of some concern in this study.

In the last section, an attempt was made to provide a theoretical framework for the present study centering around Stake's (1967) evaluation model.

CHAPTER III

THE DESIGN AND THE EVALUATION PROCEDURE

Introduction

The main purpose of this evaluation was to assess the "state of affairs" in the mathematics B-option in Alberta. Through the use of Stake's (1967) evaluation model it was possible to determine how congruent the "Observations" and "Intents" were and how the "Observations" measured up to established "Standards of excellence." In additiom, the model provided a theoretical frame within which the relationship among the variables could be explored.

In order to ensure best coverage of all relevant aspects in the program, three different samples have been used employing a number of instruments.

THE FUNCTION OF THE INSTRUMENTS IN STAKE'S MODEL

The Descriptive Matrix

Intents column: This column was completed using the statements of intent that were made by the Department of Education prior to and during the 1969/70 school year. Only statements of intent related to the variables under consideration were recorded. This enabled the investigator to determine congruency between observational data and original intents. (See FIGURE 3.00, p.42 for a layout of statements and data in the model).

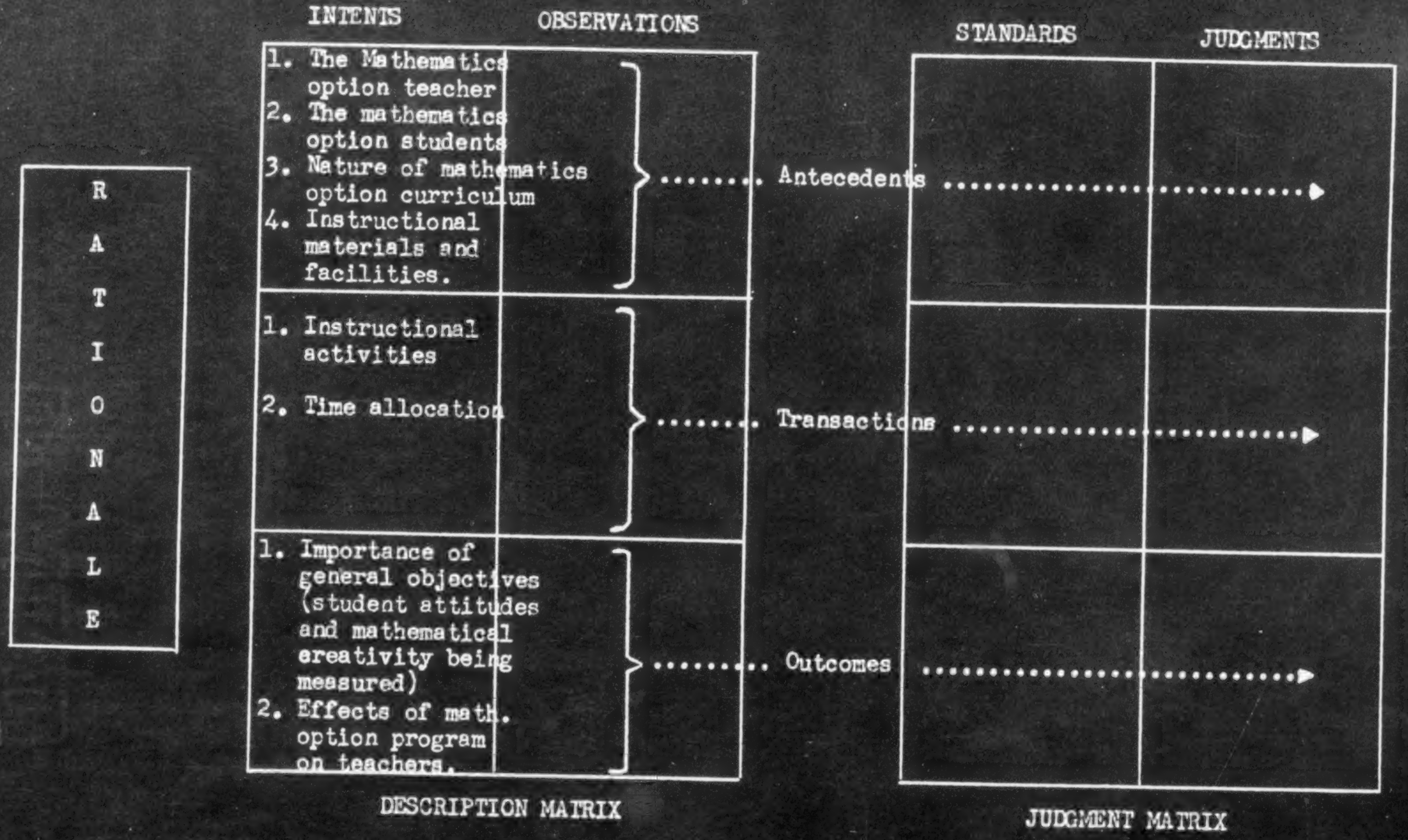
INTENTS
OBSERVATIONS
STANDARDS
JUDGMENTS
R A T I O N A L E
1. The Mathematics option teacher
2. The mathematics option students
3. Nature of mathematics option curriculum
4. Instructional materials and facilities.
Antecedents
1. Instructional activities
2. Time allocation
Transactions
1. Importance of general objectives (student attitudes and mathematical creativity being measured)
2. Effects of math. option program on teachers.
Outcomes
DESCRIPTION MATRIX
JUDGMENT MATRIX

FIGURE 3.00: A layout of statements and data to be collected by the evaluator.

Observation column: Observational data were obtained by using various techniques. These data were then classified and recorded as antecedents, transactions, and outcomes. (See FIGURE 3.00, p.42). Antecedent data were obtained through the Mathematics Option Teacher Questionnaire, Teacher Interview, and Mathematics Option Student Questionnaire as were the transaction data.

"Observed outcomes" focused on two areas: (1) general objectives of mathematics B-option and (2) the effect of the mathematics option program on the teacher. In addition to determining the importance of the stated general objectives, the investigator administered an attitude test (TIME 1, TIME 2) and a creativity test (TIME 1, TIME 2) that assessed the mathematics option students' attitude and creativity in relation to the students not enrolled in mathematics option. The data for this cell in the matrix were gathered using the Mathematics Option Teacher Questionnaire, Teacher Interview, Semantic Differential Attitude Test, and the Test of Creative Ability in Mathematics.

The Judgment Matrix

Standards column: Standards were established by recording expectations as expressed by the mathematics option teachers on the questionnaire and by the investigator. These were absolute standards since they were reflections of personal judgments.

The performances of the non-mathematics option groups on the attitude test and creativity test were used as standards for behavioral outcomes for the mathematics option group. The measures of the non-mathematics option groups were relative standards since they reflected characteristics of an alternate group.

Judgment column: Judgment was rendered by the investigator and involved judging with respect to absolute standards and judging with respect to relative standards. In each instance it was a decision related to the relative congruence of observations and intents, observations and standards, and to empirical contingencies. An overall judgment of the merit and worth of the mathematics B-option program was also given by considering the combined measures of the evaluation.

ANALYSIS OF DESCRIPTIVE DATA

Congruence Analysis

The congruence analysis involved establishing the extent to which discrepancies among observations and intents, and observations and standards occured.

The goals and objectives of the mathematics option program as well as other statements of intent, related to the variables in this study, were often not available or else not explicitly stated. This, of course, prevented the investigator from completely determining the degree of congruence of intents and observations.

In contrast to the observational data, the intents were general statements for which no empirical base existed, thus permitting only a descriptive congruence analysis of intents and observations. The comparison of observations and standards was carried out using statistical and descriptive procedures. (The degree to which observations matched intents and standards is discussed in CHAPTER V of this thesis).

Specifically, the questions that this analysis attempted to answer were:

1. To what extent are the observed antecedents congruent to the intended antecedents and antecedent standards with particular reference to the mathematics option teacher, mathematics option student, nature of curriculum, and instructional materials and facilities?
2. To what extent are the observed transactions congruent to the intended transactions and standards of transaction, with particular reference to instructional activities and time allocation?
3. To what extent are the observed outcomes congruent to the intended outcomes and standards of outcomes, with particular reference to students' attitude, creative ability in mathematics, and the effect of the program on teachers?

Contingency Analysis

For Stake this analysis involves finding the contingencies among antecedents, transactions, and outcomes. Whenever Intents are evaluated the contingency criterion is one of logic. In order to test the logic of these contingencies the evaluator relies on previous experience, research literature or a panel of experts. An example of a typical question is, "If a teacher has given qualifications, and students have certain backgrounds, and then one applies a certain instructional method is it reasonable to expect attainment of the intended outcomes?" If there exists a logical connection between these events, then the outcomes are said to be logically contingent upon the antecedent and transaction conditions.

Observation contingencies depend on empirical evidence and the data from the Mathematics Option Teacher Questionnaire made this evaluation possible. In an attempt to reduce the complexity of this type of analysis, it was decided to consider the relationship of two categories of data variables at one time.

The major null hypotheses which were tested are stated below. It was also thought that, before stating the null hypotheses, a short explanatory paragraph might improve the clarity of each null hypotheses.

Explanation of Null Hypotheses 1 and 2: Of considerable interest in this study was the professional and academic background of the mathematics option teachers and their level of satisfaction in teaching the mathematics option course. The null hypotheses that were formulated were concerned with the relationship of the professional and academic background of the mathematics option teachers and their level of satisfaction in teaching the mathematics option.

H_1 - There is no significant relationship between the professional background of mathematics option teachers and their level of satisfaction in teaching the mathematics option. (See Questions 5, 6, and 111 of MOTQ)

H_2 - There is no significant relationship between the academic background of mathematics option teachers and their level of satisfaction in teaching the mathematics option. (See Questions 8, 10 and 111 of MOTQ)

Explanation of Null Hypotheses 3: One question on the Mathematics Option Teacher Questionnaire (MOTQ) gathered information on the teachers' mathematics background and another question ascertained information with regard to the methods of assigning teachers to teach mathematics option. Whether or not the mathematics background determined the method of assignment was of interest in the following null hypothesis.

H_3 - There is no significant relationship between the mathematics background of mathematics option teachers and their assignment to teach the mathematics option. (See Questions 8, and 12 of MOTQ)

Explanation of Null Hypotheses 4 and 5: The mathematics option program being completely unstructured requires the teacher to develop his own curriculum. All teachers indicated on the MOTQ how they judged their ability to develop a curriculum in the mathematics option. This judgment was then related to their professional and academic background resulting in the following two null hypotheses.

H_4 - There is no significant relationship between the professional background and the ability to develop a curriculum in the mathematics option. (See Questions 5, 6 and 36 of MOTQ)

H_5 - There is no significant relationship between the academic background and the ability to develop a curriculum in the mathematics option. (See Questions 8, 19 and 36 of MOTQ)

Explanation of Null Hypotheses 6 and 7: One of the original intents of the mathematics option was to avoid substantial overlap of program content with the content of the core mathematics program. Again, teachers indicated on the MOTQ the amount of overlap of the mathematics option program content with the core mathematics program content. The null hypotheses that follow sought to uncover the possible relationship of professional and academic background with the amount of overlap.

H_6 - There is no significant relationship between the professional background and the amount of overlap of the mathematics option program content with the core mathematics program content. (See Questions 5, 6 and 31 of MOTQ)

H_7 - There is no significant relationship between the academic background and the amount of overlap of the mathematics option program content with the core mathematics program content. (See Questions 8, 10 and 31 of MOTQ)

Explanation of Null Hypothesis 8: This null hypothesis looks at the possible relationship of the teacher's ability to develop a curriculum and the extent to which he wishes structure imposed on the mathematics option. Teachers were given 5 ratings with regard to their ability to develop a curriculum and 5 alternatives with respect to the amount of structure that they wished imposed. The claim of no relationship of the responses to these two questions is the content of the next null hypothesis.

> H_8 - There is no significant relationship between the ability of teachers to develop a curriculum in mathematics option and the amount of structure that they wished imposed. (See Questions 36 and 37 of MOTQ)

ANALYSIS OF JUDGMENT DATA

Standards: Absolute standards for the variables in the antecedent cell and transaction cell (See FIGURE 3.00, p.42) were established by the teachers through the "Should be" responses on the Mathematics Option Teacher Questionnaire. Wherever possible, standards were explicity stated permitting a comparison with the data of the description matrix.

The performances of the non-mathematics option students on the attitude test and creativity test were chosen as the relative standards for behavioral outcomes for the mathematics option group.

Standards for "materials and facilities" were difficult to establish because of the diversity of programs throughout Alberta. However, in order to judge the availability of materials and facilities to mathematics option teachers, the investigator decided arbitrarily to consider some of the items basic necessities in any program. Items 41, 42, 49, and 50 of SECTION D of the Mathematics Option Teacher Questionnaire were thus considered basic necessities. Another arbitrary decision was made with respect to an acceptable standard for these four basic necessities. It was decided that 75 percent of the ratings should be in the "good" or "very good" response categories for each of the basic items.

Another aspect that was observed and did not permit explicit statements of standards was "the effect of the program on the teacher."

But in an attempt to determine whether the program had any unusual effects on the teachers, it was decided to examine the original intents from which a set of absolute standards was derived. More explicit statements concerning these standards are made in CHAPTER 1V.

Judgment: The purpose of judgment in this study was to evaluate aspects of the mathematics option program in light of the given data. The bases for judgment were absolute standards as established by the teachers and the investigator and relative standards as established by using the test results of students in the non-mathematics option group.

"Judgment" was to determine the congruence of the observations with the intents and standards, establish empirical contingencies and provide a complete evaluation picture by combining all measures that this evaluation produced.

STATISTICAL ANALYSIS OF DATA

Data analysis was performed using the IBM 360/67 computer and programs documented by the Division of Educational Research at the University of Alberta.

The nature of the questions and the instruments that were used to answer these questions determined the statistical procedures employed. In some cases the data from the same instrument were subjected to a number of different statistical procedures.

The data analysis for each instrument and the intended use of the results are outlined below.

Mathematics Option Teacher Questionnaire

In analyzing the data gathered through this instrument, a number of statistical procedures were necessary. The responses to the questions on this instrument were used to provide answers to the questions raised in the congruence and contingency analyses. Chi square tests of independence were performed to determine whether the responses to the "What is" questions were congruent to the responses to the "What should be" questions. Chi square tests of independence were also used in the contingency analysis, relating two specific categories of data variables. In each case, an alpha level of .05 was used as the confidence level to indicate that significant relationships existed.

The computer also produced one-way classifications of all the items on this instrument. This provided the investigator with frequencies and percentages of all responses for all distractors. Some additional manipulations of the data were considered necessary in SECTIONS D, E, and G of this instrument. Section D of the instrument deals with materials and facilities. The percentages of the "good" and "very good" response category for each item were added. This enabled comparisons to be made with the arbitrarily established standards of this section.

In SECTION E of the instrument, dealing with instructional modes, a frequency count was used to place instructional modes in rank order for the "AT PRESENT" and "SHOULD BE" modes of instruction according to the frequency of responses to the "frequently" and "often" categories combined. This enabled the determination of the extent to which each of the instructional modes is used and should be used. In order to determine whether these rankings were different, it was arbitrarily decided to consider a difference of five or more ranks an important difference between the two ratings on each item.

In SECTION G of the instrument, dealing with general objectives, the mean rating for each objective was calculated. On the basis of these mean scores, the objectives were then ranked from the high priority objective to the low priority objective. This permitted the investigator to determine the degree of importance of each objective as perceived by the teachers.

The one-way classification of all items and the additional manipulations of the data of SECTIONS D, E, and G of this instrument were then used to provide answers to questions 6 to 16 of CHAPTER I.

The major questions of interest were:

1. What are the criteria in assigning teachers to teach the mathematics option?
2. What are the criteria in selecting students for the mathematics option?
3. What is the degree of involvement of students in selecting curricular content?
4. How do students help to structure the mathematics option program?
5. How do teachers judge the availability of materials and facilities for mathematics option?
6. What is the importance of the various instructional modes in mathematics option?
7. What is the present time allotment in mathematics option in various schools and how do teachers judge its adequacy?
8. What is the degree of importance of the stated objectives in the mathematics option program?
9. What is the effect of the mathematics option program on the teacher?
10. What is the effect of the mathematics option program on the students?
11. What is the general nature of the mathematics option curriculum?

Mathematics Option Student Questionnaire

The data from this instrument were analyzed separately for each school and in total, including all mathematics option students in this sample. Only one-way classifications were computed.

The main reason for its administration was to ascertain the students' perception of the mathematics option and related variables. In addition, the data provided an important source for answering some of the questions on page 51.

Semantic Differential Attitude Test

All students participating in this study were asked to respond to this test at TIME 1 and TIME 2. The purpose of this test was to determine whether differences in attitude toward a number of concepts existed between the mathematics option group and non-mathematics option group on both occasions.

The 9 concepts that were selected for semantic differentiation were presented in the following order: Mathematics, My Math Teacher Is, Myself, Taking a Math Test Is, My School, My Math Class Is, My Classmates Are, My Math Textbook Is, and Math Homework Is. Each concept was followed by the same set of 18 scales. These scales were arranged randomly in two respects (1) the polarity of the scales (eq. good - bad or bad - good) and (2) the order of the scales. (The pilot study report on this instrument may be found in Appendix E of this thesis).

The number of subjects responding to this test at TIME 1 and TIME 2 were 428 and 417, respectively. Each of the 9 concepts was then subjected to a principal component factor analysis using a varimax rotation. The number of factor categories for each concept was equal to the number of eigenvalues greater than one. This produced a range of 2 to 4 factor categories for the concepts at TIME 1 and TIME 2. On the basis of the factor loadings the investigator identified the evaluative factor for each concept. (See TABLE I.01 and TABLE I.02 of APPENDIX I for factor loadings by concept). Factor loadings of the scales belonging to the evaluative dimension showed high loadings. The loadings at TIME 1 ranged from .53 to .82 with the majority of the scales having loadings .70 and higher. Similarily at TIME 2 where the loadings ranged from .49 to .84 with the majority of scales also having .70 or higher loadings. Once the evaluative factors for each concepts were identified, the loadings of the rotated factor matrix were then used to convert the raw scores to factor scores with a mean of 50 and standard deviation of 10. Each student had now a single evaluative score for each concept at TIME 1 and TIME 2. It was now possible to use the t test analysis for independent samples to compare the mean evaluative scores of mathematics option students in each school by grade at TIME 1 and TIME 2. An alpha level of .05 was used as the confidence level to indicate that a significant difference between two groups existed.

The educational questions related to this data are found in CHAPTER I (p. 4). Translated into null hypotheses these questions become:

H_9 - There is no significant difference in attitude between the students in the mathematics option group and students in the non-mathematics option group toward the nine concepts selected at TIME 1.

H_{10} - There is no significant difference in attitude between the students in the mathematics option group and students in the non-mathematics option group toward the nine concepts selected at TIME 2.

Test of Creative Ability in Mathematics

The students who participated in this study wrote FORM A of this test at TIME 1 and FORM B at TIME 2. This produced two raw scores for each student.

The analysis of the data involved t tests comparing mathematics option students with non-mathematics option students in each school by grade at TIME 1 and TIME 2. An alpha level of .05 was used as the confidence level to indicate that a significant difference between two groups existed.

The educational questions related to this data are found in CHAPTER I (p. 4). Translated into null hypotheses these questions become:

H_{11} - There is no significant difference in creative ability in mathematics between the students in the mathematics option group and the students in the non-mathematics option group at TIME 1.

H_{12} - There is no significant difference in creative ability in mathematics between the students in the mathematics option group and the students in the non-mathematics option group at TIME 2.

Teacher Interview

The main purpose of this instrument was to ascertain information regarding particular situations in mathematics option throughout Alberta. After the completion of the interview, all responses to the questions were transcribed onto a master sheet. Then each item was analysed for common response categories. The responses to each category were then totalled using frequencies only. The intended use of the data was purely exploratory and descriptive. These data, together with the students' test results, were used in a descriptive analysis that was carried out for each participating school.

The Study Population

Teacher Sample: This sample consisted of two hundred randomly selected mathematics B-option teachers in Alberta.

From the Form A cards, submitted by each school to the Department of Education, it was determined how many schools offer mathematics option in the province of Alberta. From the same records it was established that approximately 425 teachers constituted the total mathematics option teacher population in Alberta. The random sample of 200 teachers, selected from this population, represents approximately 47 percent of the total mathematics option teacher population. (See TABLE 3.01 for summary of teacher sample breakdown).

The teachers in this sample were then asked to respond to the Mathematics Option Teacher Questionnaire (MOTQ). Each questionnaire was accompanied by a covering letter explaining the instrument and the purpose of this study. The teachers were also informed that individual responses would be treated in confidence. In addition, each teacher received two self-addressed and stamped envelopes. One was provided for the return of the completed questionnaire and in the other they were to mail their address if they wished a copy of the results.

After an elapsed time of 10 days, 69 percent of the questionnaires were returned. Then a follow-up letter was sent to the teachers which resulted in 8 percent more returns. After the second follow-up letter another 8 percent of the questionnaires were returned. No additional questionnaires were received after mailing the third follow-up letter (See APPENDIX B of this thesis for covering letter and the follow-up letters).

All questionnaires returned were checked for completeness. TABLE 3.00 presents an analysis of returns. The high percentage of returns (85) was seen as an indication of the interest and concern of teachers in the mathematics B-option and its evaluation.

TABLE 3.00

CLASSIFICATION OF RESPONSES TO QUESTIONNAIRE

CLASSIFICATION	NUMBER	PERCENT
RETURNED AND USABLE	160	80
RETURNED, BUT NOT USABLE	10	5
NOT RETURNED	30	15
TOTALS	200	100

The reasons for excluding 10 questionnaires were:

1. blank returns (4), with teachers indicating that due to staff changes mathematics option had been dropped.
2. incompleteness (5) to the extent that whole sections had been omitted and other sections were also incomplete.
3. that one teacher felt that the instrument was biased in favor of the mathematics option and thus did not complete the instrument beyond the first page.

Student Sample: Students were selected from eleven junior high schools in Alberta that offered mathematics option. The guiding principle in the selection of schools was maximum geographical coverage of Alberta. In all, nine superintendents granted permission to conduct this evaluation within their school system. (A list of the participating schools and school systems may be found in APPENDIX A of this thesis).

From each division/county/district the investigator selected one school at random that offered mathematics option. The Edmonton system was the only exception to the number of participating schools and selection procedure. Here, three schools were chosen that were willing to participate. In all eleven schools, the principal and teachers consented to participate.

The student population consisted of the MATHEMATICS OPTION GROUP and the NON-MATHEMATICS OPTION GROUP. Ten students were randomly selected from each of the grades seven, eight, and nine who were taking the mathematics option and assigned to the mathematics option group.

From each of the grades seven, eight and nine in the same school, ten students were randomly selected who were not taking mathematics option. These students were assigned to the non-mathematics option group. This process of assigning students to the appropriate group was repeated in all participating schools.

Both groups were asked to complete a SEMANTIC DIFFERENTIAL ATTITUDE TEST (SDAT) and a TEST OF CREATIVE ABILITY IN MATHEMATICS (TOCAIM). In addition, the mathematics option groups in each school were asked to complete a questionnaire regarding their perception of mathematics option. (See TABLE 3.02 for sequence of test administration).

At TIME 1 (February 1974) the student sample consisted of 428 students with 228 students enrolled in the mathematics option program and 200 students not taking mathematics option. Because some of the students left school during the year the effective sample size at TIME 2 (May 1974) was reduced to 417 students. There was an actual loss of 6 subjects, but in order to maintain equal group size in the schools where subjects were lost, the investigator decided to drop subjects from the corresponding group at random. This was done in five instances. In one school the loss of a subject did not require the random removal of another since there were no non-mathematics option students.

A summary of the participating schools by grade and sample size may be found in APPENDIX A of this thesis.

Teacher Interview Sample: This sample consisted of seventeen mathematics option teachers who taught the students who belonged to the mathematics option group sample. The inclusion of these teachers in this sample was automatic once the schools and students were selected.

An interview was conducted with each teacher in this sample and the results were used to gain a better understanding of student performances.

A copy of the interview schedule, interview procedure, and instructions may be found in APPENDIX H of this thesis.

TABLE 3.01

SUMMARY OF BREAKDOWN OF TEACHER SAMPLE

LOCATION	NUMBER OF SCHOOLS OFFERING MATH OPTION	NUMBER OF SCHOOLS INCLUDED IN SAMPLE	NUMBER OF TEACHERS SELECTED FOR SAMPLE	% OF TEACHERS INCLUDED IN SAMPLE BY LOCATION
Calgary	49	32	37	18.5
Edmonton	50	33	39	19.5
Grande Prairie	3	1	1	.5
Lethbridge	4	4	4	2.0
Medicine Hat	2	1	1	.5
Red Deer	2	2	2	1.0
Sherwood Park	3	3	3	1.5
St. Albert	4	2	5	2.5
Others	108	107	108	54.0
Total	225	185	200	100.0

INSTRUMENTATION

Five instruments were used to collect data for this evaluation: (1) Mathematics Option Teacher Questionnaire, (2) Questionnaire for Students in Mathematics Option, (3) Semantic Differential Attitude Test, (4) Test of Creative Ability in Mathematics, and (5) Teacher Interview.

A brief description of each instrument and its function in the evaluation is given below. Each instrument and a description of the pilot study reports may be found in the appendix of this thesis.

Mathematics Option Teacher Questionnaire (MOTQ)

This questionnaire was administered to 200 randomly selected mathematics option teachers in an effort to gather information with regard to (1) The Mathematics Option Teacher, (2) The Mathematics Option Student, (3) The Nature of the Mathematics Option Curriculum, (4) Instructional Materials and Facilities, (5) Instructional Activities, (6) Time Allocation, (7) General Objectives of the Mathematics Option Program and (8) Effects of the Program on the Teacher. The questions on this questionnaire were, in most instances, stated twice. One question asked the teachers to report "What is" and the other question asked "What should be". This design provided the investigator with observational data and information as well as standards by using the "What should be" responses. Teachers did not have to sign their name thus ensuring complete anonymity of the responses.

This instrument was designed by the investigator. The pilot study report of this instrument may be found in Appendix D of this thesis.

Questionnaire for Students in Mathematics Option (QSMO)

This instrument was designed by the investigator. Many questions were constructed parallel to the questions on the MOTQ so that comparison of student and teacher opinions was possible. Only the students in the mathematics option group were asked to respond to the questions on this instrument. The main purpose of this instrument was to ascertain the students' perception of various aspects of the mathematics option program. Students did not have to sign their name on this questionnaire. This was done in the hope that truer responses could be obtained.

The pilot study report of this instrument may be found in APPENDIX F of this thesis.

Semantic Differential Attitude Test (SDAT)

The attitude of students toward a number of concepts was measured using the semantic differential format. This instrument was administered to the mathematics option group and non-mathematics option group twice - February, 1974 (TIME 1) and May, 1974 (TIME 2). The concepts presented for "semantic differentiation" were: Mathematics, My Math Teacher is, Myself, Taking a Math Test Is, My School, My Math Class Is, My Classmates Are, My Math Textbook Is, and Math Homework Is. Each concept was followed by 18 five-point bipolar adjective scales. The concepts included were not specifically related to mathematics option. This was done in an effort to get some measure of the students' attitude toward concepts that were common to both groups' experiences.

The purpose of the instrument was to detect differences in attitude toward the concepts between the mathematics option group and non-mathematics option group at TIME 1 and TIME 2. The responses to this test were anonymous.

The pilot study results may be found in APPENDIX E of this thesis.

Test of Creative Ability in Mathematics (TCAM)

This test has been developed by Dr. D. A. Buckeye (1970) and has two parallel forms. FORM A and FORM B were administered to both groups at TIME 1 (February 1974) and TIME 2 (May 1974), respectively. This test was timed and the scores were used as an indication of the students' creative ability in mathematics. Reasons for selecting this test were primarily those of expediency due to time limitations, applicability to the grades in this study and availability of norms.

The purpose of the instrument was to determine if differences in creative ability in mathematics existed between the two groups. The students were asked to place their name on this test. This was done for two reasons: (1) it was hoped that students would exert greater effort in completing this test and (2) to be able to identify students who have shown unusually high ability.

The norms of this test are summarized and may be found in APPENDIX G of this thesis.

Teacher Interview Schedule

Teacher interviews were conducted in all schools in which student-testing was carried out. The purpose of these interviews was to ascertain information from the teachers that may explain test performance of the students and some of the responses rendered on the mathematics option student questionnaire.

The interview schedule, interview procedure, and instructions may be found in APPENDIX H of this thesis.

Sequence of Test Administration

In all schools, except those in Edmonton, the administration of the various instruments to students was carried out by the regular classroom teachers. The tests were administered during regular class periods at the convenience of the teachers. Each school received, along with the test, a set of instructions related to the administration of these tests. A copy of these instructions may be found in APPENDIX C .

During February 1974 (TIME 1) the students in both groups were scheduled for the SEMANTIC DIFFERENTIAL ATTITUDE TEST (SDAT) and the TEST OF CREATIVE ABILITY IN MATHEMATICS (TCAM). Students were told beforehand of these tests and they were advised that the results would not in any way influence their school record. This procedure was repeated at the end of May 1974 (TIME 2) using the same students. However, at TIME 2 the mathematics option students were asked, in addition to the other two tests, to respond to the Mathematics Option Student Questionnaire (MOSQ). The time required for administration of all instruments in sequence was approximately 40 minutes at TIME 1 and 60 minutes at TIME 2. (See TABLE 3.02 for Summary of Sequence of Test Administration).

The Semantic Differential Attitude Test was administered first while the other instruments followed in any order. This was considered important in order to avoid the possibility of expressing their frustrations during the creativity test on the attitude test.

TABLE 3.02

SUMMARY OF SEQUENCE OF TEST ADMINISTRATION

INSTRUMENTS / ADMINISTERED TO	MATHEMATICS OPTION TEACHER QUESTIONNAIRE	STUDENT ATTITUDE TEST		CREATIVITY TEST IN MATHEMATICS		MATHEMATICS OPTION STUDENT QUESTIONNAIRE	TEACHER INTERVIEW
		TIME 1	TIME 2	TIME 1 Form A	TIME 2 Form B		
TEACHERS N = 200	ADMINISTERED in April, 1974						
TEACHERS N = 18							Conducted during April and May, 1974
MATHEMATICS OPTION STUDENTS N = 228		Admin in Feb/74	Admin in May/74	Admin in Feb/74	Admin in May/74	Admin in May, 1974	
NON-MATH OPTION STUDENTS N = 200		Admin in Feb/74	Admin in May/74	Admin in Feb/74	Admin in May/74		

Assumptions and Limitations

Assumptions: The administration of the instruments and the nature of the two questionnaires necessitated two assumptions. It was assumed that all previously prepared instructions were followed during the administration of the instruments and that all subjects understood the questionnaire in the same way. It was also assumed that all subjects being tested, interviewed and asked to fill in a questionnaire were completely honest.

Limitations: A number of limitations existed due to the nature and circumstances under which the study was conducted. It is therefore, important that these limitations are considered when interpreting this study.

One limitation of this study was due to the fact that only a limited number of variables was considered. This did not permit cause and effect determination, but rather the establishment of relationships among variables.

The test which was used to assess mathematical creativity presented another limitation in that it only assessed the fluency aspect of creativity. An additional limitation of this test was the timing of each part. This may have had an inhibitory effect on creative expressions.

The attitude test which was used had also an inherent limitation. This was primarily due to the limited number of concepts. Other concepts that may have been important to the attitude formation related to mathematics were unrecognized in this study.

With the exception of the Test of Creative Ability in Mathematics, the instruments used were designed by the investigator, and had been subjected to limited piloting procedures.

CHAPTER 1V

RATIONALE, INTENTS, OBSERVATIONS AND STANDARDS

Introduction

This chapter is divided into four distinct sections. Section 1 is concerned with presenting the rationale of the Alberta Junior High School program. The presentation of the rationale was considered by Stake an essential and integral part of program evaluation. It outlines the philosophic background and basic purpose of the program and provides a basis for evaluating intents.

The second section deals with the original intents of the mathematics B-option program in Alberta. This section presents statements of intent as they were made by the Department of Education prior to and during the 1969/70 school year. Only statements of intent related to the variables that were being considered in this study were recorded.

The third section presents the observations as they relate to the variables presented in CHAPTER 111 (See FIGURE 3.00, p. 42).

The last section of this chapter presents standards as they relate to the variables in this study.

RATIONALE OF THE JUNIOR HIGH SCHOOL PROGRAM IN ALBERTA

The implementation of a new junior high school curriculum in Alberta in 1969 was guided by a number of important considerations.

It was argued that schools are meant for children in which they can develop, grow, and have enjoyable experiences. Second, the development of children takes place in a transaction or interaction between student and teacher, around certain materials and experiences that may collectively be called the curriculum. Third, if children fail to develop and grow, as one can reasonably expect they should, the shortcomings or errors should be sought in the structure of the system and not in the innards of the children. The educational system is run by adults with power, resources, and control. If students fail to learn then the school has failed to teach them. A fourth consideration was that of equal educational opportunities for all children. This meant that every child was to have completely equal rights and claim upon the full measure of facilities and rewards of the school.

These four basic considerations were to convey the message that schools should not be structured and conducted as though the primary intent were to process children through a set of preconceived drills and exercises, which must be either passed or failed. The notion of passing or failing has only one clear-cut implication that the school is a competitive race between different kinds of children, only some of whom will succeed. It is the right of every child to receive twelve or thirteen years of education and it is an obligation of the educational system to provide as much chance for development as is possible in these twelve or thirteen years.

T he rationale behind the new Alberta junior high school curriculum is not one that advocates that all subject matter is inherently good and virtuous. It suggests that a curriculum is good or bad depending on what it does for the students. There is one major question to ask when choosing curriculum: What do we want our children to become? Translated into somewhat more operational questions, these would include: What do we want our children to value? From what do we want them to get pleasure? What do we want them to understand about themselves and the world of nature and man? How do we want them to behave toward other human beings? What technical abilities do we wish to cultivate in them?

Questions raised in these terms transform curriculum development onto a meaningful level and it is then possible to ask what has to be present in the way of teacher behavior, student behavior, materials, experiences, and supporting school factors that will enable that relationship to produce the desired outcome in the child.

It is this kind of thinking that surrounded the decision to implement a new approach to junior high school programming.
(Dr. S. N. Odynak, 1969)

INTENTS OF THE MATHEMATICS B-OPTION PROGRAM

Based on the rationale of junior high school programming in Alberta, the Department of Education implemented the B-option program in 1969 and with it came a new set of expectations, herein called intents.

What were these intents of the B-option program or in particular the mathematics B-option program? Since intents were stated in many areas it was thought that they should be summarized for each area.

The list of intents is rather incomplete and in some instances it was difficult to translate the intents in operational terms. The Department of Education had never summarized what the proposed option program was to achieve. Nevertheless, here are some of the intents as they were seen by the investigator.

Intended Antecedents

The Mathematics Option Teacher:

1. The teachers should be capable of assessing the resources of the school and the interests and abilities of students.
2. The teachers should be capable of assessing their own abilities and talents.
3. The teachers teaching mathematics option should possess adequate knowledge and ability.
4. The teachers should develop their own mathematics option program.
5. The teachers should have an idea of the objectives, content,and framework of mathematics option.

The Mathematics Option Student:

1. The students in mathematics option should be selected on the basis of strength rather than weakness.
2. It was intended that students should be aware of the objectives, content, and framework of the mathematics option.

The Nature of the Mathematics Option Curriculum:

1. The mathematics option program was expected to be structured on the basis of student interest.
2. It was intended that students should be given the opportunity to contribute to the selection of learning experiences and program content.
3. It was intended that students should be given the opportunity to consult with their teachers regarding the content of the mathematics option program.
4. It was intended that the mathematics option program is structured in such a way so that the topics investigated do not overlap substantially the topics investigated in core mathematics.
5. It was seen to be important to utilize resources of the community and environment to demonstrate possible applications of mathematics.
6. Mathematics option was intended to provide for the needs, interests, and abilities of the students.
7. Mathematics option was intended to enable students to explore their own growing interests and abilities with an emphasis on individualizing a student's program.
8. Mathematics option was not intended to be structured by the Department of Education.

Instructional Materials and Facilities:

1. It was intended that mathematics option be offered only where resources permit.

Intended Transaction

Instructional Activities:

1. The intended modes of instruction that were to be stressed were: Individual programs
   Library research
   Field trips and excursions
   Math-lab experiments

(Note: These are not in order of improtance.)

Time Allocation:

1. The Department of Education intended to be flexible and proposed a time range from 75 to 175 minutes per week.
2. There was no specific intent with regard to the program length but it was suggested that modular scheduling for the options was very useful.

Intended Outcomes

General Objectives:

1. It was intended that students develop positive attitudes and positive concept of self and others.
2. It was intended that students develop the ability to think critically.
3. It was intended that students develop basic skills.

Effects of the Program on the Teachers:

1. It was intended that teachers are free to innovate and develop their own option program.

2. It was intended to improve the level of satisfaction among teachers who were only teaching according to a prescribed course outline.

PRESENTATION OF OBSERVATIONS

The results that are presented in this section were obtained through the mathematics option Teacher Questionnaire and mathematics option Student Questionnaire. In order to follow the same sequence as is shown in FIGURE 3.00 on page 42, it was decided to present the results on the variables in the following order: (1) The mathematics option teacher, (2) The mathematics option students, (3) The nature of the mathematics option curriculum, (4) Materials and facilities, (5) Instructional activities, (6) Time allotment, (7) General objectives of mathematics option, and (8) The effect of the program on the teacher.

Observational Antecedents

The Mathematics Option Teacher

The information that was obtained on the mathematics option teacher related to sex, teaching experience, academic background, procedures used for assigning mathematics option teachers, teachers' judgment of their adequacy of preparation to teach mathematics option, teachers' judgment of the difficulty level of curriculum development in mathematics option, and the teachers' judgment of their ability in relation to other staff members.

Of the 160 teachers who responded to the questionnaire, 120 (75%) were males and 40 (25%) were females. From TABLE 4.00 it is evident that the majority of the teachers (71.9%) had more than three years teaching experience at the junior high school level. A relatively small number of teachers (6.2%) who taught mathematics option had no teaching experience at the junior high school level.

The teaching experience of teachers in mathematics option is fairly evenly distributed over the response categories (see TABLE 4.00). More than four-fifth of the teachers had at least one year of experience in teaching mathematics option. Slightly less than 20% taught mathematics option for the first time.

TABLE 4.00

DISTRIBUTION OF TEACHERS BY TEACHING EXPERIENCE IN JUNIOR HIGH SCHOOL AND IN MATHEMATICS OPTION

N=160

YEARS OF EXPERIENCE	AT JUNIOR HIGH SCHOOL		IN MATH. OPTION	
	FREQ.	PERCENT.	FREQ.	PERCENT.
NO EXPERIENCE	10	6.2	30	18.8
ONE YEAR	7	4.4	17	10.6
TWO YEARS	15	9.4	35	21.9
THREE YEARS	13	8.1	34	21.2
MORE THAN THREE	115	71.9	44	27.5

TABLE 4.01 shows that the majority of the teachers (93.1%) have some mathematics background with the number of courses ranging from one to more than nine courses. Only a small number of teachers (6.9%) were noted to have no mathematics courses.

TABLE 4.01

DISTRIBUTION OF TEACHERS BY NUMBER OF UNIVERSITY MATH. COURSES

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
NONE	11	6.9
1-3 COURSE(S)	43	26.9
4-6 COURSES	52	32.5
7-9 COURSES	40	25.0
MORE THAN 9	14	8.7

Table 4.02 gives some indication of the background of teachers in curriculum and instruction courses (ED. CI.) in mathematics. A considerable number of teachers (18.8%) had no ED. CI. courses in mathematics. The largest portion of the teachers (43.1%) indicated that they had ½ to 1 method course in mathematics. Over 24% of the teachers had 1½ to 2 courses. There is a rapid decrease in the last two response categories with 9.4% of the teachers having 2½ to 3 courses and only 4.4% having more than 3 methods courses in mathematics.

TABLE 4.02

DISTRIBUTION OF TEACHERS BY NUMBER OF CURRICULUM AND INSTRUCTION COURSES (ED. CI.) IN MATHEMATICS

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS FREQ.	NUMBER OF TEACHERS PERCENT.
NONE	30	18.8
½ - 1 COURSE	69	43.1
1½ - 2 COURSES	39	24.4
2½ - 3 COURSES	15	9.4
MORE THAN 3	7	4.4

Table 4.03 provides a summary of teacher responses to the question related to their assignment to teach the mathematics option. Thirty five percent of the teachers indicated that they had been assigned by the principal to teach mathematics option. No indication was given as to the basis of the principals' decisions. Some 26% of the teachers stated that they chose to teach mathematics option. The bases for their assignment were training in mathematics (13.1%), teaching experience at junior high school level (10.0%) or a combination of the two. The school staff, as a decision-making body in assigning teachers to teach mathematics option, was used to a very limited extent (2.5%). Some teachers (13.1%) felt that the assignment to teach mathematics option should be a joint effort involving the teacher and principal, taking training in mathematics and teaching experience at the junior high school level into account.

TABLE 4.03

DISTRIBUTION OF TEACHER RESPONSES RELATED TO THE QUESTION OF ASSIGNMENT PROCEDURE IN MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS FREQ.	NUMBER OF TEACHERS PERCENT.
a. ON BASIS OF TRAINING IN MATHEMATICS	21	13.1
b. ON VOLUNTEER BASIS	42	26.2
c. ON BASIS OF TEACHING EXP. AT JUN. HIGH	16	10.0
d. BY SCHOOL STAFF	4	2.5
e. BY PRINCIPAL	56	35.0
OTHER: TEACHER/PRINCIPAL CONSULTATION (Based on a. and c.)	21	13.1

Table 4.04 presents the responses of the teachers as they judged the adequacy of their preparation to teach mathematics option. Slightly over 40% of the teachers felt they were "very well" or "extremely well" prepared to teach the mathematics option. The majority of the teachers (53.8%) indicated adequate preparation and 5.6% felt that they were either "poorly" or "very poorly" prepared. The combined percentages of the last two response categories (5.6%) of TABLE 4.04 are fairly close to the number of teachers having no university mathematics courses (TABLE 4.01) and to the number of teachers not having taught at the junior high school level (TABLE 4.00).

TABLE 4.04

DISTRIBUTION OF TEACHERS' JUDGMENT REGARDING THEIR ADEQUACY OF PREPARATION TO TEACH MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
EXTREMELY WELL	22	13.7
VERY WELL	43	26.9
ADEQUATELY	86	53.8
POORLY	7	4.4
VERY POORLY	2	1.2

Table 4.05 presents the responses of teachers as they judged the difficulty level of curriculum development in the mathematics option. A small number of teachers (3.7%) appear to have no difficulty as they judged it to be a very easy task. A larger portion of the teachers (37.5%) found curriculum development no more difficult than planning for other subjects. The majority of the teachers (58.7%) judged it to be "more difficult than other subjects" and "very difficult". None of the teachers felt that curriculum development in mathematics option was beyond their ability.

Teachers were also asked to judge if they were the best qualified teachers on staff to teach the mathematics option. The responses indicated that 55.6% of the teachers felt that they were best qualified. Almost one-half of the teachers seemed to think that there were better qualified teachers on staff to teach the mathematics option.

TABLE 4.05

DISTRIBUTION OF TEACHER RESPONSES JUDGING THE DIFFICULTY LEVEL OF CURRICULUM DEVELOPMENT IN MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
VERY EASY TASK	6	3.7
NO MORE DIFFICULT THAN PLANNING FOR OTHER SUBJECTS	60	37.5
MORE DIFFICULT THAN OTHER SUBJECTS	73	45.6
VERY DIFFICULT TASK	21	13.1
BEYOND MY ABILITY	-	-

The Mathematics Option Students

The data and information for this part were obtained from teachers and students. The questions of interest were related to student selection as it was seen by the teachers and students, grouping practices of students, characteristics of mathematics option students as judged by teachers, and distinguishing characteristics of mathematics option students and non-mathematics option students.

TABLE 4.06 presents the responses of the teachers to the question of selection procedure of students for mathematics option. The data indicates that the majority of the teachers (52.5%) felt that it is the students' personal choice to select mathematics option. Only 1.9% of the teachers responded that they were the sole decision-makers in the selection process. That it was the school administration's decision to place students into mathematics option was judged by 8.1% of the teachers. None of the teachers felt that it was the sole decision of the parents. In 13.1% of the schools the mathematics option course is compulsory. Under "others" teachers (24.4%) indicated it is a joint decision of the teacher, administrators, and students.

TABLE 4.06

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF STUDENT ASSIGNMENT TO MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. PERSONAL CHOICE	84	52.5
b. TEACHER'S DECISION	3	1.9
c. ADMINISTRATION'S DECISION (eg. COUNSELLOR, PRINCIPAL)	13	8.1
d. PARENTS' DECISION	-	-
e. COMPULSORY COURSE	21	13.1
f. OTHER: COMBINATION OF a, b, and c	39	24.4

TABLE 4.07 represents the responses of 224 mathematics option students as they decribe the reasons for choosing mathematics option. Of this sample, 46.0% indicated that they chose mathematics option because of their interest in mathematics. The number of students choosing it because of the teacher (1.3%), friends (4.5%), timetable conflict (9.8%), teacher's advice (4.0%), curiosity (6.3%), and easy marks (1.8%)

is relatively small. A considerable number of students (26.3%) were choosing it for the opportunity of receiving additional help in core mathematics.

TABLE 4.07

DISTRIBUTION OF STUDENT RESPONSES TO THE QUESTION REGARDING THE REASONS FOR THEIR CHOICE OF MATHEMATICS OPTION

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
a. INTEREST IN MATHEMATICS	103	46.0
b. LIKE MY TEACHER	3	1.3
c. MY FRIENDS ALSO TAKE IT	10	4.5
d. TIMETABLE CONFLICT	22	9.8
e. TEACHER'S ADVICE	9	4.0
f. OTHERS:		
NEED ADDITIONAL HELP IN CORE MATHEMATICS	59	26.3
CURIOSITY	14	6.3
EASY MARKS	4	1.8

TABLE 4.08 shows the responses of the students to the statement, "Taking Math. Option was my own free choice." A total of 77.7% of the students agreed or strongly agreed that taking the mathematics option was their own free choice. The remainder of the students was undecided (7.1%), disagreeing (9.8%), or strongly disagreeing (5.4%) with this statement.

TABLE 4.08

DISTRIBUTION OF STUDENT RESPONSES TO THE STATEMENT
"TAKING MATH OPTION WAS MY OWN FREE CHOICE"

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	86	38.4
AGREE	88	39.3
UNDECIDED	16	7.1
DISAGREE	22	9.8
STRONGLY DISAGREE	12	5.4

Another question was related to the practices of grouping students for mathematics option. TABLE 4.09 shows the teacher responses to this question. Only two distinct categories were considered. The majority of the teachers (82.5%) indicated that grouping of students was heterogeneous with respect to mathematical ability. Only 17.5% of the teachers group their mathematics option students homogeneously with respect to mathematical ability.

TABLE 4.09

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF GROUPING MATHEMATICS OPTION STUDENTS

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS FREQ.	NUMBER OF TEACHERS PERCENT.
HOMOGENEOUS WITH RESPECT TO MATHEMATICAL ABILITY	28	17.5
HETEROGENEOUS WITH RESPECT TO MATHEMATICAL ABILITY	132	82.5

Teachers were also asked to describe some characteristics of the mathematics option students in general. TABLE 4.10 shows the responses related to these characteristics. Slightly under one-fifth of the teachers (18.1%) stated that the mathematics option students were in general those who needed remedial help in core mathematics. A very small percentage of the teachers (5.0%) indicated that the mathematics option students have a high ability in mathematics. Students in mathematics option have generally positive attitudes toward mathematics. This was claimed by 28.8% of the teachers. Almost one-half of the teachers (48.1%) pointed out that one can find a wide range of abilities, interests, and attitudes among students in the mathematics option classes.

TABLE 4.10

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF THE CHARACTERISTICS OF MATHEMATICS OPTION STUDENTS

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. REMEDIAL STUDENTS	29	18.1
b. HIGH MATH. ABILITY STUDENTS	8	5.0
c. STUDENTS WITH POSITIVE ATTITUDES TOWARD MATHEMATICS	46	28.8
d. OTHER COMBINATION OF a, b, and c	77	48.1

TABLE 4.11 represents the responses of teachers as they describe the characteristics of mathematics option students in relation to non-mathematics option students. A large portion of the teachers (38.1%) felt that there were no differences between mathematics option students and non-mathematics option students in terms of ability in and attitudes toward mathematics. A considerable number of teachers (32.5%) have indicated that mathematics option students do have better attitudes toward mathematics than non-mathematics option students. The responses to the other categories were relatively small with 5.0% of the teachers indicating that mathematics option students have greater ability in mathematics, 4.4% of the teachers indicated that mathematics option students were more creative in mathematics and 20% of the teachers felt that they had both, better attitudes toward mathematics and that they were creative in mathematics.

TABLE 4.11

CHARACTERISTICS OF MATH. OPTION STUDENTS (MOS) IN RELATION TO NON-MATH. OPTION STUDENTS (NMOS). (Teacher responses)

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. MOS HAVE BETTER ATTITUDE TOWARD MATHEMATICS	52	32.5
b. MOS HAVE GREATER ABILITY IN MATHEMATICS	8	5.0
c. MOS ARE MORE CREATIVE IN MATHEMATICS	7	4.4
d. NO DIFFERENCE BETWEEN MOS AND NMOS IN ABILITY AND ATTITUDE	61	38.1
e. OTHER: MOS HAVE BETTER ATTITUDES AND ARE MORE CREATIVE	32	20.0

The Nature Of The Mathematics Option Curriculum

In this section the focus is on the general nature of the mathematics option curriculum as it is seen by teachers and students. The questions raised had to be quite general because of the diversity of programs. Of particular interest were: (1) the types of programs, (2) the extent of students' contributions to the program, (3) how students contribute to the program, (4) the question of content overlap with core mathematics as seen by teachers and students, (5) the extent of using community resources, (6) the extent to which the curriculum provides for the needs, interests and abilities of students, (7) students' perception on the extent to which they could pursue an individual program, (8) the extent to which the mathematics option program in Alberta is structured, and (9) the students' opinion regarding the question of continuing the present mathematics option program.

TABLE 4.12 presents teacher responses to the question regarding the type of mathematics option program which they offer. The largest proportion of the teachers (40.0%) classified their program "a general interest course". An enrichment course was offered by 21.2% of the teachers. A remedial course for students with problems in regular mathematics was offered by 16.9% of the teachers. Approximately twelve percent of the teachers were able to set up a program that provided for individual interest and abilities. The last response category "other" produced three distinct combinations. Three teachers (1.9%) felt that their program was a combination of a general interest course and an enrichment course. Seven teachers (4.4%) offered a combination of remedial and general interest course. Another type of program that was offered was a remedial program with provisions for individual interests and abilities. This program was offered by 3.1% of the teachers.

TABLE 4.12

DISTRIBUTION OF TEACHER RESPONSES AS TO THE TYPE OF MATHEMATICS OPTION COURSE THEY OFFERED

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS FREQ.	NUMBER OF TEACHERS PERCENT.
a. REMEDIAL COURSE FOR STUDENTS WITH PROBLEMS IN REGULAR MATH	27	16.9
b. ENRICHMENT COURSE	34	21.2
c. GENERAL INTEREST COURSE	64	40.0
d. PROVIDING FOR INDIVIDUAL INTEREST AND ABILITIES	20	12.5
e. OTHER:		
Combination of b and c	3	1.9
Combination of a and c	7	4.4
Combination of a and d	5	3.1

The extent to which students contribute to the selection of curricular content in mathematics option is summarized in TABLE 4.13. The results show that nearly one-half of the teachers (49.3%) gave students a chance to contribute to some extent to the selection of curricular content. A relatively large proportion of the teachers (34.4%) indicated that their students contribute to a very little extent only. For 6.9% of the teachers the response was "to a great extent". Almost ten percent of the teachers (9.4%) indicated that their students did not contribute to the selection of curricular content in the mathematics option.

TABLE 4.13

DISTRIBUTION OF TEACHER RESPONSES REGARDING THEIR JUDGMENT OF THE EXTENT TO WHICH STUDENTS CONTRIBUTE TO THE SELECTION OF CURRICULAR CONTENT

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
TO A GREAT EXTENT	11	6.9
TO SOME EXTENT	79	49.3
TO A VERY LITTLE EXTENT	55	34.4
NOT AT ALL	15	9.4

It was also of interest to find out from the teachers how students contribute or help to structure the mathematics option program. TABLE 4.14 presents the teachers' responses to this question. The large proportion of the teachers (29.4%) indicated that they provide a pool of suggestions from which the students select activities. An equally large proportion of the teachers (29.4%) indicated that students suggest activities which are then organized to plan a program for the whole class. Nearly one-quarter of the teachers (22.5%) felt that the limited background of the students does not permit them to help. Only 5.6% of the teachers were able to plan an individual program based on that individual's suggestions. Twenty-one teachers (13.1%) indicated that they, in cooperation with the students, analyze the needs and interests of the students and then plan a program that is appropriate for that group.

TABLE 4.14

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION ON HOW STUDENTS HELP TO STRUCTURE THE MATHEMATICS OPTION PROGRAM

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
BY WAY OF SUGGESTING ACTIVITIES WHICH ARE THEN USED TO ORGANIZE A PROGRAM FOR THE WHOLE CLASS	47	29.4
EACH STUDENT SUBMITS SUGGESTIONS WHICH ARE THEN USED TO PLAN AN INDIVIDUAL PROGRAM FOR THAT STUDENT	9	5.6
STUDENTS SELECT ACTIVITIES FROM A POOL OF SUGGESTIONS SUBMITTED BY THE TEACHER	47	29.4
THE LIMITED BACKGROUND DOES NOT PERMIT THE STUDENTS TO HELP	36	22.5
OTHER: JOINT EFFORT OF STUDENTS AND TEACHER	21	13.1

The amount of overlap of the content of the mathematics option program with the core mathematics program was described by teachers (TABLE 4.15) and students (TABLE 4.16).

TABLE 4.15 shows that 43.8% of the teachers have "as little as possible" an overlap of the content of mathematics option with core mathematics content. A "moderate" overlap of content was indicated by 40.6% of the teachers. The "substantial" and "very substantial" overlap was reported by 9.4% and 6.2%, respectively.

TABLE 4.15

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF OVERLAP OF MATHEMATICS OPTION CONTENT WITH CORE MATHEMATICS CONTENT

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
VERY SUBSTANTIAL	10	6.2
SUBSTANTIAL	15	9.4
MODERATE	65	40.6
AS LITTLE AS POSSIBLE	70	43.8

The responses by students to the question of content overlap are recorded in TABLE 4.16. Students were asked to describe the amount of overlap of mathematics option content with core mathematics content by indicating the frequency with which topics from core mathematics were included in mathematics option. Slightly over one-fifth of the students indicated that their teachers included topics from core mathematics in mathematics option "all of the time" (4.5%) and "much of the time" (16.1%). Four-fifth of the students responded "sometimes" (39.7%), "very little of the time" (30.8%), and "never" (8.9%).

TABLE 4.16

MATHEMATICS OPTION INCLUDES TOPICS THAT ARE TAKEN IN THE REGULAR MATHEMATICS PROGRAM. (Student responses)

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
ALL OF THE TIME	10	4.5
MUCH OF THE TIME	36	16.1
SOMETIMES	89	39.7
VERY LITTLE OF THE TIME	69	30.8
NEVER	20	8.9

The extent to which resources of the community and environment were utilized in mathematics option is shown in TABLE 4.17. A small percentage of the teachers (1.2%) have indicated that resources of the community and environment were utilized "most of the time". The frequent use was indicated by 15.0% of the teachers. Greater percentage responses were found in the "sometimes" and "seldom" categories. Each category contained 36.3% of the teacher responses. The claim of "never" utilizing the resources of the community and environment in mathematics option was made by 11.2% of the teachers.

TABLE 4.17

THE EXTENT TO WHICH RESOURCES OF THE COMMUNITY AND ENVIRONMENT ARE USED IN MATHEMATICS OPTION. (Teacher responses)

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
MOST OF THE TIME	2	1.2
FREQUENTLY	24	15.0
SOMETIMES	58	36.3
SELDOM	58	36.3
NEVER	18	11.2

The effectiveness of the teachers' mathematics option program in terms of being able to provide for the needs, interests, and abilities of the students was of considerable interest. This judgment, as it was provided by the teachers, was made according to the categories shown in TABLE 4.18. The majority of the teachers (66.9%) indicated that their mathematics option program did provide for the needs, interests, and abilities of "most students". Just over 30 percent of the teachers felt that they were only able to provide for the needs, interests, and abilities of "some students". Approximately one percent thought that they were able to provide for "all students", and one percent of the teachers felt that their program provided for only "very few students" in terms of their needs, interests, and abilities.

TABLE 4.18

MY MATHEMATICS OPTION PROGRAM PROVIDES FOR THE NEEDS, INTERESTS, AND ABILITIES OF: (Teacher Responses)

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
ALL STUDENTS	2	1.2
MOST STUDENTS	107	66.9
SOME STUDENTS	49	30.6
VERY FEW STUDENTS	2	1.2

It was of particular interest to ascertain the students' perception on the extent to which the mathematics option program allowed students to pursue individual work in areas of interest. TABLE 4.19 shows the distribution of the responses. A major portion of the students (37.5%) responded "sometimes", 25.4% felt that they were only "very little of the time" allowed to work in any area of interest, and almost one-fifth of the students indicated that they were "never" allowed to work in any area of interest to them. Only 4.9% of the students were granted permission to work "at all times" in areas of interest to them and 12.5% of the students had this permission "much of the time".

TABLE 4.19

DISTRIBUTION OF STUDENT RESPONSES TO THE QUESTION OF BEING ALLOWED TO WORK IN AREAS OF INTEREST IN MATH. OPTION

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
ALL OF THE TIME	11	4.9
MUCH OF THE TIME	28	12.5
SOMETIMES	84	37.5
VERY LITTLE OF THE TIME	57	25.4
NEVER	44	19.6

Observations with respect to the amount of structure in mathematics option can be summarized as follows:

At the time mathematics option is completely unstructured and it is the responsibility of the teachers who teach mathematics option to develop a curriculum for the course.

Ascertaining the opinion of students, with respect to the question of whether or not mathematics option should continue to be offered in its present form, was of great interest in this study. TABLE 4.20 shows the results to this question. From the data it appears that the majority of students (76.3%) either "agree" or "strongly agree" with the continuation of the present program. Some 16 percent of the students were undecided and approximately 8 percent either "disagreed" or "strongly disagreed" with the continuation of mathematics option in its present form.

TABLE 4.20

MATHEMATICS OPTION SHOULD CONTINUE TO BE OFFERED THE WAY IT IS. (Student Responses)

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	69	30.8
AGREE	102	45.5
UNDECIDED	36	16.1
DISAGREE	13	5.8
STRONGLY DISAGREE	4	1.8

The students' opinion regarding the adoption of an unstructured curriculum in other courses was also of some interest. TABLE 4.21 shows the results. It is interesting to note that, although 50% of the students favor the adoption of such a curriculum in other subjects, a considerable increase in the "undecided" category has taken place when compared to the "undecided" responses of TABLE 4.20. This may suggest that students are not quite willing to discard all structured programs in the various subjects.

TABLE 4.21

OTHER COURSES SHOULD BE ORGANIZED IN THE SAME WAY AS THE MATHEMATICS OPTION. (Student Responses)

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	36	16.1
AGREE	78	34.8
UNDECIDED	83	37.1
DISAGREE	21	9.4
STRONGLY DISAGREE	6	2.7

Materials and Facilities

This section contains the summary of the teachers' responses to the ratings of materials and facilities. Thirteen categories of materials and facilities were listed which were rated by the teachers using the following rating scale. A rating of (1) indicated "not desirable to have", (2) "not applicable or none-existent", (3) "poor, should be improved", (4) "fair, needs attention", (5) "good, satisfactory," and (6) "very good, highly effective".

The distribution of the responses are shown in TABLE 4.22. Rather than discussing the responses to all of the thirteen items it was felt that some comments regarding items 41, 42, 49, and 50 would suffice. The selection of these four items was based on the argument of Chapter III in which it was stated that these were considered basic necessities in any mathematics option program.

TABLE 4.22 presents the teachers' responses as they rated the condition of each of the items at their school. The responses to items 41, dealing with Journals in Mathematics and Science, ranged over all rating scales. Only 2 teachers felt that possession of mathematics and science journals was not desirable. These responses could have been made in the light of their own programs which may not require the use of this kind of reference material. Twenty percent of the teachers indicated that mathematics and science journals were not available at their school. Approximately one-third of the teachers described conditions as poor and 26.2% of the teachers rated their conditions as being fair. The "good" and "very good" categories combined have been responded to by less than 20% of the teachers. The "very good" category is almost negligible since only one teacher described the situation as being so.

The conditions with respect to mathematics reference books were described as being "fair" by a large portion of the teachers (37.5%). Only 4.4% of the teachers indicated that mathematics reference books are non-existent and 26.9% described the situation as being "poor". Some 31% of the teachers responded to the "good" and "very good" categories combined. The fact that none of the teachers responded to "not desirable to have" can be taken as an indication that reference materials are considered essential in a mathematics option program.

Item 49 of TABLE 4.22 attempted to get some ratings on very basic materials. The majority of the teachers (55%) described the situation as being good and satisfactory and another 8.1% of the teachers rated it "very good". A considerable number of teachers (22.5%) indicated that the situation is fair and needs attention. Only 3.7% of the teachers responded to the "non-existent" category. Again, the possession of basic materials and supplies for projects can be taken as a necessity for mathematics option since none of the responses were found in the "not desirable to have" category. The same inference can be drawn from the responses to item 50 of TABLE 4.22. Eleven teachers (6.9%) indicated that mathematical instruments were not available at their schools. A major portion of the teachers (35.0%) described the situation as being "poor" and 26.9% of the teachers rated "fair, needs attention". The responses to the "good" and "very good" categories combined amounted to 31.2% of the teachers.

TABLE 4.22

DISTRIBUTION OF TEACHER RESPONSES TO THE RATINGS OF MATERIALS AND FACILITIES

N = 160

ITEMS	RATINGS					
	1	2	3	4	5	6
38. MATHEMATICS LABORATORY	3.1 (5)	54.4 (87)	15.0 (24)	15.6 (25)	11.2 (18)	.6 (1)
39. STORAGE FACILITIES FOR SUPPLIES AND EQUIPMENT		13.7 (22)	34.4 (55)	23.8 (38)	24.4 (39)	3.7 (6)
40. LIBRARY	.6 (1)	3.7 (6)	27.5 (44)	32.5 (52)	31.3 (50)	4.4 (7)
41. JOURNALS IN MATHEMATICS AND SCIENCE	1.2 (2)	20.0 (32)	33.1 (53)	26.2 (42)	18.8 (30)	.6 (1)
42. MATHEMATICS REFERENCE BOOKS (OTHER THAN TEXTBOOKS)		4.4 (7)	26.9 (43)	37.5 (60)	26.9 (43)	4.4 (7)
43. INDIVIDUAL LEARNING PAKAGES (UNIPAKS)	3.7 (6)	50.6 (81)	21.9 (35)	9.4 (15)	10.0 (16)	4.4 (7)
44. TEACHER-PREPARED MATERIALS, AS PROJECT OUTLINES, GUIDES, ETC.	.6 (1)	12.5 (20)	27.5 (44)	30.0 (48)	23.8 (38)	5.6 (9)
45. MATHEMATICAL GAMES AND PUZZLES	.6 (1)	5.6 (9)	21.9 (35)	25.0 (40)	33.7 (54)	13.1 (21)
46. VISUAL AIDS SUCH AS GRAPHS, DIAGRAMS, CHARTS AND MODELS		9.4 (15)	36.3 (58)	31.9 (51)	19.4 (31)	3.1 (5)
47. MATHEMATICS FILMS AND VIDEO-TAPES	1.9 (3)	38.7 (62)	30.6 (49)	21.9 (35)	5.0 (8)	1.9 (3)
48. FILMSTRIPS AND SLIDES IN MATHEMATICS	1.9 (3)	22.5 (36)	41.3 (66)	24.4 (39)	8.7 (14)	1.2 (2)
49. MATERIALS AND SUPPLIES FOR PROJECTS (eg. Construction paper, glue, wood, etc.)		3.7 (6)	10.6 (17)	22.5 (36)	55.0 (88)	8.1 (13)
50. MATHEMATICAL INSTRUMENTS SUCH AS: SLIDE RULES, PROTRACTORS, PARALLEL RULES, COMPASSES, CALCULATING MACHINES, ETC.		6.9 (11)	35.0 (56)	26.9 (43)	26.2 (42)	5.0 (8)

*Note: The numbers enclosed in braces represent the frequencies.

One question was also posed to students asking them to offer their opinions on the availability of materials and facilities for projects in mathematics option. This was written in the form of a statement and students indicated their opinion by checking either (1) strongly agree, (2) agree, (3) undecided, (4) disagree, or (5) strongly disagree. The results are recorded in TABLE 4.23.

Over fifty percent of the students responded to the "strongly agree" and "agree" categories combined. Some thirty percent of the students were in doubt and checked the "undecided" category. The "disagree" and "strongly disagree" categories were selected by 15.2% and 2.7% of the students, respectively.

TABLE 4.23

STUDENT RESPONSES "We have always enough materials and facilities for projects in mathematics option."

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	34	15.2
AGREE	81	36.2
UNDECIDED	69	30.8
DISAGREE	34	15.2
STRONGLY DISAGREE	6	2.7

Observational Transactions

Instructional Activities

Data for this section were obtained from the teachers and students. Teachers were asked to indicate the extent to which each of the 18 instructional modes were used in their programs using a five point rating scale. A check of scale (1) indicated never, (2) seldom, (3) moderately, (4) frequently, and (5) often. These instructional modes were then ranked according to the frequency of responses in the frequently and often categories combined (See TABLE 4.24).

The contributions of students to this section were considered of some importance. Three questions were asked in relation to this section. One question ascertained the students' perception on the kind of grouping that was used for mathematics option instruction (See TABLE 4.25). Another question that is indirectly related to this section dealt with the students' perception of the teacher's basis for marking (See TABLE 4.26). Finally, students were asked to offer their opinions on the fairness of their teacher's marking (See TABLE 4.27).

TABLE 4.24 shows the ranks of these instructional modes according to the frequency of responses to the "frequently" and "often" categories combined. The data revealed that pencil and paper activities (63.8%) dominated over all the other modes of instruction. A considerable drop in total percentage occurred between the modes ranked one and two. The instructional modes ranked 2, 3, 4, 5, and 6 were used "frequently" or "often" by approximately 30 percent of the teachers. Small group projects, drill practice, and individual student/teacher conferences were "frequently" or "often" used by approximately one quarter of the teachers.

It is interesting to note that "field trips and excursions" and "resource persons from community", two potentially useful modes of instruction in mathematics option, have been ranked rather low as far as the present use of these modes was concerned.

TABLE 4.24

RANK ORDER OF INSTRUCTIONAL MODES ACCORDING TO THEIR OBSERVED FREQUENCY OF USE IN MATHEMATICS OPTION

N = 160

RANK	INSTRUCTIONAL MODE	PERCENTAGE RESPONSE		
		F*	O**	TOTAL
1.	PAPER-PENCIL ACTIVITIES	39.4	24.4	63.8
2.	INDIVIDUAL PROJECTS	17.5	19.4	36.9
3.	CLASS DISCUSSIONS	26.2	5.6	31.8
4.	TEACHER DEMONSTRATION	23.1	8.1	31.2
5.	MATHEMATICAL GAME APPROACH	21.2	8.7	29.9
6.	SMALL GROUP DISCUSSION	23.1	6.2	29.3
7.	SMALL GROUP PROJECTS	20.0	6.2	26.2
8.	DRILL PRACTICE	16.2	8.1	24.3
9.	INDIVIDUAL TEACHER/STUDENT CONFERENCES	13.7	9.4	23.1
10.	MATH-LAB EXPERIMENTS	13.7	3.7	17.4
11.	CLASS PROJECTS	15.0	1.9	16.9
12.	TEACHER LECTURE	13.1	2.5	15.6
13.5	LIBRARY RESEARCH	8.1	1.2	9.3
13.5	INDIVIDUAL LEARNING PACKAGES (UNIPAKS)	6.2	3.1	9.3
15.	STUDENT DIRECTED CLASS DISCUSSIONS	6.9	1.9	8.8
16.	FIELD TRIPS AND EXCURSIONS	2.5	.6	3.1
17.5	RESOURCE PERSONS FROM COMMUNITY	1.9	-	1.9
17.5	FILMS, SLIDES, AND FILMSTRIPS	1.9	-	1.9

* "frequently" used mode of instruction
** "often" used mode of instruction

TABLE 4.25 summarizes the student responses to the question of the most frequent arrangement of students in mathematics option. It appears that students work primarily by themselves (42.4%) and in small groups (36.2%). Only 12.9% of the students reported that they work mostly as part of the whole class. Eight percent of the students indicated that the individual and small group arrangement was mostly used. One student (.5%) could not isolate the most frequent arrangement and described it as being a combination of individual, small group, or class work.

TABLE 4.25

DISTRIBUTION OF STUDENT RESPONSES TO THE QUESTION OF THE MOST FREQUENT ARRANGEMENT IN GROUPING FOR MATHEMATICS OPTION INSTRUCTION

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
BY MYSELF	95	42.4
IN SMALL GROUPS (2 or 3)	81	36.2
AS PART OF THE WHOLE CLASS	29	12.9
OTHER:		
MYSELF AND SMALL GROUP	18	8.0
MYSELF, SMALL GROUP, AND WHOLE CLASS	1	.5

TABLE 4.26 shows the results of students' perception of the way in which they see themselves marked by their teachers. Three response categories were provided and students indicated that they were either

marked on the same basis as in regular mathematics, a different basis from regular mathematics, or that they are not marked in mathematics option. If the students selected the second choice, " a different basis from regular mathematics ", then they were to describe the basis for marking in their mathematics option program. There were 108 students (48.2%) who indicated, but only 62 students (27.7%) described the way they are marked. The descriptions were then classified into five distinct response categories which are shown under " Description of different basis " in TABLE 4.26. The data indicated that over 40 percent of the students described the basis of their teacher's marking mathematics option to be the same as that of the regular mathematics program. Close to one-half of the students recognized that their teachers used a different basis for marking mathematics option. Only 8.0% of the students indicated that they were not marked in mathematics option. These 8.0% were distributed over six different schools and it appeared rather inconsistent with the responses of the other students. It is probably true that these students had no knowledge of the type of marking procedure that was used by their teachers.

Twenty seven students (12.1%) felt that they were marked on the basis of their projects and participation. Neatness and quantity were seen to be the basis for marking by 7.1% of the students. Test performance as a basis for marking was claimed by 5.8% of the students. Only 1.8% of the students indicated that their attitude was used as the basis for marking performance in mathematics option. Two students (.9%) did not know on what basis they were marked in mathematics option.

TABLE 4.26

DISTRIBUTION OF STUDENT RESPONSES REGARDING THE BASIS OF THEIR TEACHER'S MARKING IN MATHEMATICS OPTION

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS FREQ.	NUMBER OF STUDENTS PERCENT.
SAME BASIS AS IN REGULAR MATHEMATICS	98	43.8
DIFFERENT BASIS FROM REGULAR MATHEMATICS	108	48.2
NOT MARKED IN MATHEMATICS OPTION	18	8.0
DESCRIPTION OF DIFFERENT BASIS:		
NEATNESS AND QUANTITY	16	7.1
ON PROJECTS AND PARTICIPATION	27	12.1
TEST PERFORMANCE	13	5.8
ON ATTITUDE	4	1.8
DON'T KNOW	2	.9

It was also of interest to ascertain the opinions of students as to the fairness of their teachers' methods of marking or grading. The responses are shown in TABLE 4.27. It can be reassuring to teachers that 83.4% of the students either "strongly agree" or "agree" with the methods of marking or grading as they are presently used by teachers. Twenty three students (10.3%) had some reservations about the marking or grading by their teachers. Only 5.4% of the students either "disagree" or "strongly disagree" with their teachers' methods of marking.

TABLE 4.27

DISTRIBUTION OF STUDENT RESPONSES REGARDING THE FAIRNESS OF THEIR TEACHER'S METHOD OF MARKING OR GRADING MATHEMATICS OPTION

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	80	35.7
AGREE	109	48.7
UNDECIDED	23	10.3
DISAGREE	10	4.5
STRONGLY DISAGREE	2	.9

Time Allotment

This section focuses on the current practices in alloting time to mathematics option. All responses were converted to 40 minute periods per week for a full year course (See TABLE 4.28).

Also included in this section is a survey of the students' opinions on the sufficiency of time per week in mathematics option (See TABLE 4.29).

The lengths of the various mathematics option programs is presented in the last part of this section (See TABLE 4.30).

TABLE 4.28 indicates that nearly one-half of the teachers (41.9%) alloted three forty minute periods per week. This was followed by 33.1% of the teachers who alloted two forty minute periods per week to mathematics option. Although the time for mathematics option varied, the allotment of four and five forty minute periods per week was only found among 8.7% and 5.0% of the teachers, respectively. Eighteen teachers (11.2%) reported the use of six forty minute periods per week for the full year.

TABLE 4.28

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF TOTAL TIME PER WEEK ALLOTMENT TO MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
TWO 40 MIN. PERIODS PER WEEK	53	33.1
THREE 40 MIN. PERIODS PER WEEK	67	41.9
FOUR 40 MIN. PERIODS PER WEEK	14	8.7
FIVE 40 MIN. PERIODS PER WEEK	8	5.0
OTHER:		
SIX 40 MIN. PERIODS PER WEEK	18	11.2

TABLE 4.29 shows the student responses to the question of the sufficiency of instructional time in mathematics option. The majority of the students (72.3%) "agreed" or "strongly agreed" with the statement of having enough time per week in the mathematics option. Some eleven percent of the students were undecided and 16.1% of the students either "disagreed" or "strongly disagreed". The students disagreeing or strongly disagreeing with the sufficiency of time are not only students from a particular school where little time is used, but they were found in

9 out of 11 schools. This seems to support the claim that regardless of the amount of time alloted to mathematics option, there will always be some students who find it insufficient.

TABLE 4.29

DISTRIBUTION OF STUDENT RESPONSES TO THE QUESTION OF SUFFICIENCY OF TIME IN MATHEMATICS OPTION

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	58	25.9
AGREE	104	46.4
UNDECIDED	26	11.6
DISAGREE	26	11.6
STRONGLY DISAGREE	10	4.5

TABLE 4.30 provides some indication as to the current practice of handling the length of mathematics option programs in Alberta schools. The majority of the teachers (50.6%) reported that they offered mathematics option as a full year course. Fifty-eight teachers (36.3%) offered mathematics on a semester basis. Trimestering the program and modular scheduling were reported by 8.7% and 4.4% of the teachers, respectively.

TABLE 4.30

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE LENGTH OF THEIR MATHEMATICS OPTION PROGRAM

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
A FULL YEAR COURSE	81	50.6
SEMESTERED	58	36.3
TRIMESTERED	14	8.7
OTHER: MODULAR SCHEDULING	7	4.4

Observed Outcomes

General Objectives of Mathematics Option

The Mathematics Option Teacher Questionnaire contained sixteen general objectives. Each of these objectives was rated by the teachers according to the degree of importance in their mathematics option program. A five-point rating scale was used signifying: (1) very important, (2) unimportant, (3) mediocre, (4) important, and (5) very important.

A mean score for each objective was calculated on the basis of these ratings. The objectives were then ranked according to their mean score from the high priority objective to the low priority objective. While teachers provided some indication as to the importance of each objective in their program, students were asked to indicate how clear their teachers' objectives were to them.

TABLE 4.31 shows the ratings and the corresponding mean score for each objective in rank order. The data indicate that the teachers consider the development of more positive attitudes toward mathematics the most important objective of mathematics option. This fact is reflected in the high mean score (4.3) as well as in the high number of responses (90.6%) to the "important" and "very important" ratings combined. The second objective, "to develop creative thinking in mathematics", was considered to be important by 42.5% of the teachers and very important by 38.7% of the teachers. To develop the students' confidence in their ability was regarded as the third most important objective in mathematics option. The responses indicate that 41.3% of the teachers describe this objective as being important and 35.6% consider it very important.

None of the objectives received a mean score of less than 3. The development of speed and efficiency in mathematical computations was considered the least important objective in mathematics option. It received a mean score of 3.1.

TABLE 4.31

RANK ORDER OF SIXTEEN OBJECTIVES BASED ON THE MEAN SCORE OF THE RATINGS

N = 160

RANK	OBJECTIVE	RATINGS (%) 1	2	3	4	5	MEAN SCORE
1.	TO DEVELOP MORE POSITIVE ATTITUDES TOWARD MATHEMATICS	.6	1.2	7.5	45.0	45.6	4.3
2.	TO DEVELOP CREATIVE THINKING IN MATHEMATICS	-	1.9	16.9	42.5	38.7	4.2
3.	TO DEVELOP THE STUDENTS' CONFIDENCE IN THEIR ABILITY	.6	2.5	20.0	41.3	35.6	4.1
4.5	TO DEVELOP THE STUDENTS' ABILITY TO THINK CRITICALLY	.6	4.4	20.6	51.2	23.1	3.9
4.5	TO DEVELOP THE STUDENTS' ABILITY IN LOGICAL THINKING	-	5.6	21.2	49.4	23.8	3.9
6.5	TO DEVELOP A SENSE OF RESPONSIBILITY	1.2	5.6	26.2	42.5	24.4	3.8
6.5	TO DEVELOP PRECISION IN THOUGHT AND EXPRESSION	-	4.4	30.6	43.1	21.9	3.8
8.	TO PROVIDE STUDENTS WITH TIME FOR FREE EXPLORATION IN MATHEMATICS	1.9	15.6	23.8	31.9	26.9	3.7
9.	TO ALLOW THE STUDENTS TIME TO STUDY RELEVANT APPLICATION OF MATHEMATICS	.6	10.0	27.5	49.4	12.5	3.6

TABLE 4.31 (continued)

RANK	OBJECTIVE	RATINGS (%)					MEAN SCORE
		1	2	3	4	5	
11.	TO ACQUAINT STUDENTS WITH THE LOGICAL STRUCTURE OF MATHEMATICS.	1.2	10.6	32.5	46.3	9.4	3.5
11.	TO DEVELOP SKILLS IN THE RETRIEVAL AND USE OF MATHEMATICAL INFORMATION	1.9	11.9	32.5	40.0	13.7	3.5
11.	TO ALLOW THE STUDENT TO STUDY IN DEPTH A TOPIC IN MATHEMATICS OF HIS CHOICE	5.0	16.2	24.4	30.0	24.4	3.5
13.	TO DEVELOP BASIC MATHEMATICAL SKILLS	8.1	15.0	30.0	25.6	21.2	3.4
14.	TO ACQUAINT STUDENTS WITH THE CONTRIBUTIONS OF MATHEMATICS TO THE PROGRESS OF CIVILIZATION	3.1	16.2	36.9	31.3	12.5	3.3
15.	TO INCREASE THE STUDENTS' LEVEL OF ACHIEVEMENT IN REGULAR MATHEMATICS	6.2	20.6	35.0	26.2	11.9	3.2
16.	TO DEVELOP SPEED AND EFFICIENCY IN MATHEMATICAL COMPUTATIONS	9.4	21.2	33.7	21.9	13.7	3.1

Students were also approached to provide some indication as to how clear the objectives of their mathematics option program were to them. They were asked to indicate the degree of agreement to the statement, "What we are trying to do in mathematics option seems clear to me".

TABLE 4.32 shows the responses to this statement. Seventy-nine percent of the students were either strongly agreeing or agreeing to this statement. Some 13% of the students were in doubt about their teachers' objectives and 7.6% either disagreed or strongly disagreed with this statement.

TABLE 4.32

DISTRIBUTION OF STUDENT RESPONSES TO THE STATEMENT ON THE CLARITY OF THE OBJECTIVES OF THEIR MATHEMATICS OPTION PROGRAM

N = 224

RESPONSE CATEGORY	NUMBER OF STUDENTS	
	FREQ.	PERCENT.
STRONGLY AGREE	49	21.9
AGREE	128	57.1
UNDECIDED	30	13.4
DISAGREE	12	5.4
STRONGLY DISAGREE	5	2.2

Effects of the Program on the Teacher

The effect of the program on the teacher was determined by the teachers indicating their choice of response to four statements.

The statements dealt with (1) the amount of supervision required in mathematics option, (2) discipline problems in mathematics option as compared to core subjects, (3) preparation and planning time in mathematics option as compared to core subjects, (4) the amount of mental and physical strain on teachers teaching mathematics option as compared to teachers teaching core subjects, and (5) the enrollment in mathematics option classes.

The last question of this section attempted to ascertain the level of satisfaction of teachers teaching the mathematics option.

Teachers were asked to respond to the statement that "students work well with little supervision in the mathematics option". TABLE 4.33 shows the results. Less than one-half of the teachers (44.3%) either "agreed" or "strongly agreed" with that statement. A considerable number of teachers (20.6%) remained neutral in their response and 35.0% of the teachers either "disagreed" or "strongly disagreed" with the statement that students work well with little supervision in the mathematics option.

TABLE 4.33

DISTRIBUTION OF TEACHER RESPONSES TO THE STATEMENT THAT "STUDENTS WORK WELL WITH LITTLE SUPERVISION IN THE MATHEMATICS OPTION"

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
STRONGLY AGREE	9	5.6
AGREE	62	38.7
NEUTRAL	33	20.6
DISAGREE	45	28.1
STRONGLY DISAGREE	11	6.9

The responses of the teachers, to a comparative statement regarding discipline problems in the mathematics option as compared to core subjects, are recorded in TABLE 4.34. More than one-half of the teachers (53.8%) were not in agreement with the statement that there were more discipline problems in the mathematics option than in core subjects. An additional 14.4% of the teachers indicated strong disagreement with that statement. There were 19.4% of the teachers who felt that more discipline problems arise in the mathematics option than in core subjects. Some twelve percent of the teachers remained neutral.

TABLE 4.34

DISTRIBUTION OF TEACHER RESPONSES TO THE STATEMENT THAT "THERE ARE MORE DISCIPLINE PROBLEMS IN THE MATHEMATICS OPTION THAN IN CORE SUBJECTS"

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
STRONGLY AGREE	12	7.5
AGREE	19	11.9
NEUTRAL	20	12.5
DISAGREE	86	53.8
STRONGLY DISAGREE	23	14.4

TABLE 4.35 presents a summary of teacher responses to the comparative statement that "lesson preparation and planning in the mathematics option require more time than in any other subject". The majority of the teachers (53.8%) indicated that lesson preparation and planning in the mathematics option do require more time than in any other subject. Slightly under 20% of the teachers remained neutral and 26.9% either "disagreed" or "strongly disagreed" with that statement.

TABLE 4.35

DISTRIBUTION OF TEACHER RESPONSES TO THE STATEMENT THAT "LESSON PREPARATION AND PLANNING IN THE MATHEMATICS OPTION REQUIRE MORE TIME THAN IN ANY OTHER SUBJECT."

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
STRONGLY AGREE	19	11.9
AGREE	67	41.9
NEUTRAL	31	19.4
DISAGREE	38	23.8
STRONGLY DISAGREE	5	3.1

TABLE 4.36 shows the teachers' responses to the comparative statement that "there is greater mental and physical strain on teachers teaching mathematics option than on teachers teaching core subjects". Close to 37% of the teachers either "agreed" or "strongly agreed", while 45% of the teachers were either "disagreeing" or "strongly disagreeing" with this statement. Approximately 18% of the teachers remained "neutral" to this statement.

TABLE 4.36

DISTRIBUTION OF TEACHER RESPONSES TO THE STATEMENT THAT "THERE IS GREATER MENTAL AND PHYSICAL STRAIN ON TEACHERS TEACHING MATHEMATICS OPTION THAN ON TEACHERS TEACHING CORE SUBJECTS."

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
STRONGLY AGREE	17	10.6
AGREE	42	26.2
NEUTRAL	29	18.1
DISAGREE	63	39.4
STRONGLY DISAGREE	9	5.6

TABLE 4.37

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF ENROLLMENT IN MATHEMATICS OPTION CLASSES

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
UNDER 15 STUDENTS	9	5.6
15-20 STUDENTS	37	23.1
21-25 STUDENTS	35	21.9
26-30 STUDENTS	55	34.4
MORE THAN 30 STUDENTS	24	15.0

TABLE 4.37 provides some indication as to the enrollment in mathematics option classes. The data reveal that nearly 50% of the teachers reported an enrollment of 26 students and more. Very few teachers (5.6%) reported enrollment below 15 students. An enrollment of 15-20 students and 21-25 students was reported by 23.1% and 21.9% of the teachers, respectively.

The last question of this section attempted to find out how satisfied teachers were with the teaching of their mathematics option program. From TABLE 4.38 it appears that the majority of the teachers (53.8%) indicated general satisfaction with their teaching of the mathematics option. Thirteen percent were very satisfied. There were, however, 25.6% of the teachers who were either "somewhat dissatisfied" (20.6%) or "very dissatisfied" (5.0%). Only 7.5% of the teachers were "undecided" with regard to this question.

TABLE 4.38

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE LEVEL OF SATISFACTION OF TEACHERS IN THE MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
VERY SATISFIED	21	13.1
GENERALLY SATISFIED	86	53.8
UNDECIDED	12	7.5
SOMEWHAT DISSATISFIED	33	20.6
VERY DISSATISFIED	8	5.0

STATEMENTS OF STANDARDS

Three different reference groups were used to establish standards. The teachers' responses to the "should be" questions on the Mathematics Option Teacher Questionnaire provided some standards. The performance of the non-mathematics option group provided the standards for test performance for the mathematics option group. Standards for"materials and facilities" and "effect of the program on the teacher" were established by the investigator.

In order to be consistent with the sequence of presentation of the previous section, the standards are stated for: (1) The Mathematics Option Teachers, (2) The Mathematics Option Students, (3) Nature of the Mathematics Option Curriculum, (4) Materials and Facilities, (5) Instructional Activities, (6) Time Allotment, (7) General Objectives of Mathematics Option, and (8) Effect of the Program on the Teacher.

Antecedent Standards

Standards For Mathematics Option Teacher

The standards of this section include those related to: (1) teaching experience, (2) academic background, and (3) assignment procedures for mathematics option teachers.

TABLE 4.39 presents a summary of teacher responses to the question of what should be the minimum mathematics teaching experience at the junior high school level before teaching mathematics option.

TABLE 4.39

TEACHER RESPONSES TO THE QUESTION: "HOW MANY YEARS OF MATHEMATICS TEACHING EXPERIENCE AT THE JUNIOR HIGH SCHOOL LEVEL WOULD YOU CONSIDER NECESSARY BEFORE TEACHING THE MATHEMATICS OPTION?"

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
NO EXPERIENCE (BEGINNING TEACHER)	36	22.5
ONE YEAR EXPERIENCE	43	26.9
TWO YEARS EXPERIENCE	37	23.1
THREE YEARS EXPERIENCE	25	15.6
MORE THAN THREE YEARS	19	11.9

TABLE 4.40 shows a summary of teacher responses related to the question of what they feel should be the minimum mathematics background for mathematics option teachers. Approximately four-fifths of the teachers felt that mathematics option teachers should have one to six mathematics courses as background. Slightly more than 8% of the teachers felt that more than 7 courses were necessary. Some twelve percent indicated that it was not necessary at all to have mathematics courses as a mathematics option teacher.

TABLE 4.40

TEACHER RESPONSES TO THE QUESTION: "WHAT WOULD YOU CONSIDER A MINIMUM NUMBER OF UNIVERSITY MATHEMATICS COURSES IN ORDER TO TEACH THE MATHEMATICS OPTION?"

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
NONE	20	12.5
1 - 3 COURSES	69	43.1
4 - 6 COURSES	58	36.3
7 - 9 COURSES	10	6.2
MORE THAN 9	3	1.9

TABLE 4.41 presents the standard for mathematics option teachers in terms of the number of curriculum and instruction courses in mathematics. Nearly one-half of the teachers felt that ½-1 course in mathematics curriculum and instruction should be the minimum for mathematics option teachers. In all 84.6% of the teachers found curriculum and instruction courses in mathematics necessary while 15.6% did not feel it was necessary.

TABLE 4.41

TEACHER RESPONSES TO THE QUESTION: "HOW MANY CURRICULUM AND INSTRUCTION COURSES IN MATHEMATICS WOULD YOU CONSIDER NECESSARY FOR MATHEMATICS OPTION TEACHERS?"

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
NONE	25	15.6
$\frac{1}{2}$ - 1 COURSE	79	49.4
$1\frac{1}{2}$ - 2 COURSES	43	26.9
$2\frac{1}{2}$ - 3 COURSES	11	6.9
MORE THAN 3	2	1.2

TABLE 4.42 presents the standard for an assignment procedure for mathematics option teachers. Teachers (50%) pointed out that the assignment to teach mathematics option should be on a voluntary basis. Some twenty-one percent of the teachers felt that the assignment should be one of teacher/principal consultation based on training in mathematics and teaching experience at the junior high school level.

TABLE 4.42

TEACHER RESPONSES TO THE STATEMENT: "THE DECISION FOR TEACHERS TO TEACH MATHEMATICS OPTION SHOULD BE MADE".

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. ON THE BASIS OF TRAINING IN MATHEMATICS	31	19.4
b. ON VOLUNTEER BASIS	80	50.0
c. ON THE BASIS OF TEACHING EXPERIENCE AT JUNIOR HIGH SCHOOL LEVEL	8	5.0
d. BY THE SCHOOL STAFF	4	2.5
e. BY THE PRINCIPAL	3	1.9
f. OTHER: TEACHER/PRINCIPAL CONSULTATION (Based on a and c	34	21.2

Standards for Mathematics Option Students

The standards related to this section were provided by the teachers. They pertain to (1) student selection, (2) grouping practices in mathematics option, (3) characteristics of mathematics option students, (4) differences in general characteristics between mathematics option students and non-mathematics option students, and (5) grade level in which mathematics option should be taught.

TABLE 4.43 provides an indication of what teachers feel should be the selection procedure of students for mathematics option. Teachers (77.5%) clearly support that students should personally decide whether or not to enrol in mathematics option.

A combination of the student's, teacher's and administrator's decision for placement of students in mathematics option was suggested by 13.1% of the teachers.

TABLE 4.43

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF WHAT SHOULD BE THE SELECTION PROCEDURE OF STUDENTS FOR MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. STUDENT'S PERSONAL CHOICE	124	77.5
b. TEACHER'S DECISION	13	8.1
c. ADMINISTRATOR'S DECISION (eg. PRINCIPAL, COUNSELLOR)	1	.6
d. PARENT'S DECISION	-	-
e. COMPULSORY COURSE	1	.6
f. OTHER: COMBINATION OF a, b, and c	21	13.1

TABLE 4.44 provides an indication of the teachers' opinions regarding the grouping of mathematics option students. The majority of the teachers (58.8%) would like the mathematics option classes to be homogeneous with respect to mathematical ability.

TABLE 4.44

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF PREFFERED GROUPING OF MATHEMATICS OPTION STUDENTS

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
HOMOGENEOUS WITH RESPECT TO MATHEMATICAL ABILITY	94	58.8
HETEROGENEOUS WITH RESPECT TO MATHEMATICAL ABILITY	66	41.3

TABLE 4.45 shows the responses of the teachers regarding the question of preferred characteristics of mathematics option students. The data indicate that teachers prefer students with positive attitudes toward mathematics rather than high mathematical ability.

TABLE 4.45

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF PREFERRED CHARACTERISTICS OF MATHEMATICS OPTION STUDENTS

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
STUDENTS REQUIRING REMEDIAL HELP IN MATHEMATICS	16	10.0
STUDENTS WITH HIGH MATHEMATICAL ABILITY	11	6.9
STUDENTS WITH POSITIVE ATTITUDE TOWARD MATHEMATICS	130	81.2
OTHER: HIGH ABILITY AND POSITIVE ATTITUDE, REMEDIAL	3	1.9

TABLE 4.46 provides an indication of what teachers prefer to be the characteristics of mathematics option students in relation to the non-mathematics option students. One-half of the teachers felt that mathematics option students should have better attitudes toward mathematics than non-mathematics option students.

TABLE 4.46

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE QUESTION OF PREFERRED CHARACTERISTICS OF MATHEMATICS OPTION STUDENTS IN RELATION TO NON-MATHEMATICS OPTION STUDENTS

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. BETTER ATTITUDES TOWARD MATHEMATICS	80	50.0
b. GREATER ABILITY IN MATHEMATICS	13	8.1
c. MORE CREATIVE IN MATHEMATICS	17	10.6
d. NO DIFFERENCE IN MATHEMATICAL ABILITY and/or ATTITUDE TOWARD MATHEMATICS	26	16.2
e. OTHER: COMBINATION OF a, b, and c.	24	15.0

TABLE 4.47 provides a standard with respect to grade level at which mathematics option should be taught. Teachers prefer it to be taught in all three junior high school grades. This was expressed by 81.3% of the teachers.

TABLE 4.47

DISTRIBUTION OF TEACHER RESPONSES WITH RESPECT TO THE QUESTION OF PREFERRED GRADE LEVEL AT WHICH MATHEMATICS OPTION SHOULD BE TAUGHT

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
GRADE 7 ONLY	1	.6
GRADE 8 ONLY	3	1.9
GRADE 9ONLY	9	5.6
GRADE 8 AND 9 ONLY	13	8.1
GRADE 7, 8, AND 9	130	81.3
OTHER: AT ONLY ONE GRADE LEVEL DURING JUNIOR HIGH SCHOOL	3	1.9

Standards Regarding the Nature of the Mathematics Option Curriculum

The standards established in this section were provided by the teachers and deal with (1) the types of mathematics option programs, (2) the extent of students' contributions to the program, (3) the way students contribute to the program, (4) the extent of content overlap of the mathematics option program with the core mathematics option program, and (5) the extent of using community resources in the mathematics option program, and (6) the teachers' opinion on the extent to which the mathematics option program in Alberta should be structured.

The teachers' preference with regard to the type of program that should be offered is tabulated in TABLE 4.48. The general feeling is that the mathematics option program should be one that provides for individual interests and abilities of the students. This was indicated by 34.4% of the teachers. Approximately one-quarter of the teachers prefer a general interest course and 17.5% an enrichment course. Relatively few teachers (6.9%) indicated that it should be a remedial course for students with problems in regular mathematics. A combination of a remedial course and general interest course was suggested by 15.6% of the teachers.

TABLE 4.48

DISTRIBUTION OF TEACHER RESPONSES REGARDING THEIR PREFERENCE OF THE TYPE OF MATHEMATICS OPTION COURSE

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
a. REMEDIAL COURSE FOR STUDENTS WITH PROBLEMS IN REGULAR MATH.	11	6.9
b. ENRICHMENT COURSE	28	17.5
c. GENERAL INTEREST COURSE	37	23.1
d. PROVIDING FOR INDIVIDUAL INTEREST AND ABILITIES	55	34.4
e. OTHER:		
Combination of b and c	25	15.6
Combination of a and c	2	1.2
Combination of a and d	2	1.2

The extent to which students should contribute to the selection of curricular content in mathematics option is summarized in TABLE 4.49. Teachers have indicated that students should contribute "to some extent" (63.1%) and "to a great extent" (26.2%).

TABLE 4.49

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE EXTENT TO WHICH STUDENTS SHOULD CONTRIBUTE TO THE SELECTION OF CURRICULAR CONTENT IN MATHEMATICS OPTION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS FREQ.	PERCENT.
TO A GREAT EXTENT	42	26.2
TO SOME EXTENT	101	63.1
TO A VERY LITTLE EXTENT	13	8.1
NOT AT ALL	4	2.5

The content of TABLE 4.50 provided a basis for the standard on how students should contribute to the mathematics option curriculum. It is evident from the data that teachers feel that students should contribute to the program by means of suggestions which would then provide a basis for an individual or group program.

TABLE 4.50

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION ON HOW STUDENTS SHOULD CONTRIBUTE TO THE MATHEMATICS OPTION CURRICULUM

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
BY WAY OF SUGGESTING ACTIVITIES WHICH ARE THEN USED TO ORGANIZE A PROGRAM FOR THE WHOLE CLASS	44	27.5
EACH STUDENT SUBMITS SUGGESTIONS WHICH ARE THEN USED TO PLAN AN INDIVIDUAL PROGRAM FOR THAT STUDENT	50	31.3
STUDENTS SELECT ACTIVITIES FROM A POOL OF SUGGESTIONS SUBMITTED BY THE TEACHER	33	20.6
THE LIMITED BACKGROUND DOES NOT PERMIT THE STUDENTS TO HELP	19	11.9
OTHER: JOINT EFFORT OF STUDENTS AND TEACHER	14	8.7

The data of TABLE 4.51 provide a standard for what teachers considered the extent to which an overlap of the content of mathematics option with the regular mathematics program should occur. There is all indication that this overlap of content should be "as little as possible" (44.4%) and at most "moderate" (38.1%).

TABLE 4.51

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE AMOUNT OF OVERLAP THAT SHOULD OCCUR BETWEEN THE MATHEMATICS OPTION PROGRAM AND THE CORE MATHEMATICS PROGRAM

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
VERY SUBSTANTIAL	6	3.7
SUBSTANTIAL	22	13.7
MODERATE	61	38.1
AS LITTLE AS POSSIBLE	71	44.4

The extent to which community resources should be used is summarized in TABLE 4.52. The majority of the teachers (61.9%) suggested that mathematics option programs should incorporate the use of community resources at a frequent rate. "Sometimes" was suggested by 33.1% of the teachers and "never" was suggested by none of the teachers.

TABLE 4.52

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE EXTENT TO WHICH RESOURCES OF THE COMMUNITY SHOULD BE USED IN THE MATHEMATICS OPTION PROGRAM

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
MOST OF THE TIME	7	4.4
FREQUENTLY	99	61.9
SOMETIMES	53	33.1
SELDOM	1	.6
NEVER	-	-

The teachers' opinions on the extent to which the mathematics option program in Alberta should be structured are summarized in TABLE 4.53. The results revealed that the majority of the teachers (63.8%) wish mathematics option to remain unstructured but they are asking for more assistance in terms of guides, suggestions, and ideas. Only 13.1% of the teachers like mathematics option to remain as it is and the remainder of the teachers like to see changes of some kind or another. These changes range from dropping the option from the curriculum to completely structuring the mathematics option.

TABLE 4.53

DISTRIBUTION OF TEACHER RESPONSES TO THE QUESTION OF THE AMOUNT OF STRUCTURE THAT SHOULD BY IMPOSED ON THE MATHEMATICS OPTION PROGRAM BY THE DEPARTMENT OF EDUCATION

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
COMPLETELY STRUCTURED BY THE DEPARTMENT OF EDUCATION AS FOR EXAMPLE THE REGULAR MATHEMATICS	2	1.2
ABOUT ONE HALF STRUCTURED AND THE OTHER HALF DEVELOPED BY THE TEACHER	19	11.9
UNSTRUCTURED, BUT WITH MORE ASSISTANCE IN TERMS OF SUGGESTIONS AND IDEAS FROM THE DEPARTMENT OF EDUCATION	102	63.8
COMPLETELY UNSTRUCTURED AS IT EXISTS NOW	21	13.1
BECAUSE OF THE WAY IT IS OPERATING, THE OPTION SHOULD BE DROPPED	16	10.0

Standards Regarding Materials and Facilities

It was argued in CHAPTER III that the establishment of standards for materials and facilities was difficult due to the diversity of programs that were being offered throughout Alberta. The investigator thus made an arbitrary decision to consider items 41, 42, 49, and 50 of SECTION "D" of the Mathematics Option Teacher Questionnaire basic necessities. These items were:

1. Journals in Mathematics and Science.

2. Mathematics reference books (other than textbooks).
3. Materials and supplies for projects (eg. construction paper and other types, glue, wood, etc.).
4. Mathematical instruments such as slide rules, protractors, parallel rules, compasses, calculating machines, etc..

The standard that was decided upon for these four items was that 75% of the responses should be in the "good" and "very good" response categories combined for each of the basic items.

Standards for Transactions

Standard for Instructional Activities

The standards that were established for this section were provided by the teachers. Eighteen modes of instruction were listed on the questionnaire and each mode was rated by the teachers according to the extent to which it should be used in mathematics option. The ratings that were used included: (1) never, (2) seldom, (3) moderately, (4) frequently, and (5) often.

The instructional modes were then placed in rank order according to the "frequently" and "often" response categories combined (see TABLE 4.54). This permitted the investigator to determine whether the rankings of the presently used modes (see TABLE 4.24) differed from the rankings of the preferred modes (see TABLE 4.54). The investigator decided arbitrarily to consider a difference of five or more ranks an important difference between two instructional modes.

TABLE 4.54

RANK ORDER OF INSTRUCTIONAL MODES ACCORDING TO THEIR PREFERRED FREQUENCY OF USE IN MATHEMATICS OPTION

N = 160

RANK	INSTRUCTIONAL MODE	PERCENTAGE RESPONSES		
		F*	O**	TOTAL
1.	INDIVIDUAL PROJECTS	41.3	31.3	72.6
2.	MATH-LAB EXPERIMENTS	41.3	18.1	59.4
3.	SMALL GROUP DISCUSSIONS	39.4	13.7	53.1
4.	CLASS DISCUSSIONS	37.5	13.7	51.2
5.	PAPER-PENCIL ACTIVITIES	36.9	12.5	49.4
6.	SMALL GROUP PROJECTS	35.6	9.4	45.0
7.	MATHEMATICAL GAME APPROACH	34.4	10.0	44.4
8.	INDIVIDUAL TEACHER/STUDENT CONFERENCES	28.8	15.0	43.8
9.	LIBRARY RESEARCH	29.4	8.1	37.5
10.	INDIVIDUAL LEARNING PACKAGES (UNIPAKS)	20.6	8.1	28.7
11.	TEACHER DEMONSTRATION	17.5	8.7	26.2
12.	DRILL PRACTICE	18.8	6.9	25.7
13.	FIELD TRIPS AND EXCURSIONS	20.0	5.0	25.0
14.	STUDENT DIRECTED CLASS DISCUSSIONS	20.6	2.5	23.1
15.	CLASS PROJECTS	19.4	2.5	21.9
16.	FILMS, SLIDES, AND FILM STRIPS	18.1	3.1	21.2
17.	RESOURCE PERSONS FROM COMMUNITY	16.2	4.4	20.6
18.	TEACHER LECTURE	3.1	1.9	5.0

* "frequently" used mode of instruction

** "often" used mode of instruction

Standards for Time Allotment and Program Length

A standard for time allotment was determined by the teachers. The responses to the "should be" question served as the basis for that standard. It was determined that teachers considered three forty minute periods to be sufficient for instruction time per week for mathematics option.

As far as a standard for program length was concerned, teachers indicated that a semestered mathematics option course would be the best choice (See TABLE 4.55). A full year course for mathematics option was suggested by 28.8% of the teachers.

TABLE 4.55

DISTRIBUTION OF TEACHER RESPONSES REGARDING THE QUESTION OF PROGRAM LENGTH

N = 160

RESPONSE CATEGORY	NUMBER OF TEACHERS	
	FREQ.	PERCENT.
A FULL YEAR COURSE	46	28.8
SEMESTERED COURSE	79	49.4
TRIMESTERED COURSE	20	12.5
OTHER: MODULAR ORGANIZATION	15	9.4

Standards for Outcomes

Standards for General Objectives

Two objectives, attitude toward mathematics and other related concepts and mathematical creativity, were measured involving mathematics option students. The performances of the non-mathematics option students on these two tests were used as standards for attitude and mathematical creativity. The performances of the mathematics option groups of each school were then compared to the performance of the non-mathematics option groups of the same school. The results of the attitude test and the creativity test are discussed in CHAPTER VII.

Standards with Regard to the Effect of the Program on the Teacher

It was very difficult to state explicit standards with regard to the effect of the program on the teacher. This is primarily due to the fact that the effect of the program on the teacher is dependent upon a number of factors, such as, class size, teaching strategies, characteristics of the students, and many others.

Standards for this section were provided by the investigator but were largely dictated by the philosophy and original intents of the option program. Of course, the assumption made here is that schools have very closely adhered to the philosophy and original intents of the mathematics option program.

A standard, with regard to the amount of supervision of students in mathematics option, should read:

> Students work well with little supervision in the mathematics option classes.

A standard, with regard to discipline problems in mathematics option as compared to core subjects, should read:

> There should be fewer discipline problems in mathematics option than in core subjects.

A standard, with regard to the preparation and planning time in mathematics option as compared to core subjects, should read:

> Teachers will require more preparation and planning time in the mathematics option than in core subjects.

A standard, with regard to the amount of mental and physical strain on teachers teaching mathematics option as compared to teachers teaching core subjects, should read:

> That due to the intended nature of the mathematics option program, teachers would likely experience greater mental and physical strain than teachers teaching core subjects.

A standard, with regard to the class sizes for mathematics option should read:

> That the enrollment of mathematics option classes should not exceed twenty-five students.

CHAPTER V

CONGRUENCE ANALYSIS

Introduction

The content of this chapter is divided into two major sections. The first section deals with the congruence of observations with intents using descriptive analysis only.

The extent to which observations were congruent with standards is presented in the second section. Here, the investigator employed statistical and descriptive procedures

Congruence of Observations with Intents

Antecedent Variables

The Mathematics Option Teacher

It was observed that the majority of the teachers (93.8%) had at least one year teaching experience at the junior high school level before teaching mathematics option. Slightly over 80 percent taught mathematics option for at least one year already. These observations were certainly in agreement with the intents.

The data also revealed that only 6.9% of the teachers had no university mathematics courses while all others had at least one course (See TABLE 4.01). Nearly 20 percent of the teachers did not take any curriculum and instruction courses in mathematics. Although it appeared that the majority of the teachers were adequately prepared to teach mathematics option, it was, however, also found that some teachers had neither mathematics courses nor curriculum and instruction courses.

That the teachers felt adequately or better prepared to teach mathematics option was expressed by 94.4% of the teachers.

It was indicated by 45.6% of the teachers that curriculum development in mathematics option was more difficult than in other subjects. Another 13.1% described it as a very difficult task. Here, the observations seem to point to an incongruence with the intents because the development of programs was expected of teachers teaching mathematics option.

The Mathematics Option Student

It was intended that the assignment of students to mathematics option was one of personal choice but that the selection be on the basis of strength rather than weakness.

The data revealed that the majority of the students have a personal choice or else receive some guidance by the teacher and administration. Nearly 25% of the teachers responded that their students were assigned by the teacher or administrator only or that the course was compulsory. These results were confirmed by the students. Of the 224 students sampled, 46% responded that they were enrolled in mathematics option for reasons of interest in mathematics. All others had different reasons which were not in agreement with the original intent.

It was also found that mathematics option classes were not just composed of students strong in the subject (82.5% of the teachers indicated this). Nearly all classes contained students of varying mathematical ability and attitudes toward mathematics.

Only 5% of the teachers had classes of high mathematical ability and 28.8% felt that their classes had positive attitudes toward mathematics.

Nearly one-fifth of the teachers had remedial classes in mathematics and almost one-half of the teachers indicated that their classes contain remedial students, high in mathematical ability students and students with positive attitudes toward mathematics.

It may be said that the findings about the mathematics option student were not congruent with what was intended.

The Nature of The Mathematics Option Curriculum

1. Types of programs: The observations indicated that many different types of programs were being offered.

Teachers classified their courses according to four major categories. Nearly 17% offered a remedial course for students with problems in mathematics, 21% offered an enrichment course and the largest number of teachers (40%) provided a general interest course. A course that provided for individual interests and abilities was offered by only 12.5% of the teachers.

Although mathematics option was not intended to be remedial in nature, some teachers, however, felt that it was legitimate because it provided for the needs and interests of those students who wanted to improve their standing in the core mathematics.

It appeared to be a sound argument, but it must be considered incongruent with the intents because students in mathematics option were to be selected on the basis of strength and not on weakness.

2. Extent of students' contribution to the program: It was intended that students be given the opportunity to contribute to the selection of learning experiences and program content.

The observations, however, revealed that only about one-half of the teachers permit contribution to some extent and 6.9% of the teachers permit it to a great extent.

3. How students contribute to the program: There appears to be four distinct categories. Students suggest a pool of activities which form the basis of a program for the whole class. This was done by 29.4% of the teachers.

Students were also given the freedom to select activities from a pool of suggestions submitted by the teacher. This was also done by 29.4% of the teachers.

Individual programs based on the student's own suggestions were only provided by about 6% of the teachers.

Some 13% indicated that it was a joint effort of students and teachers.

None of these four categories was considered contrary or incongruent with the intents of the program. There were, however, nearly one-quarter of the teachers who felt that due to the limited background in mathematics students were not able to help.

4. Content overlap of mathematics option with core mathematics: It was intended that the mathematics option program is structured in such a way so that the topics investigated do not overlap substantially the topics investigated in core mathematics.

This intent was well carried out with over 80% of the teachers indicating the overlap to be moderate or less than moderate. About 15% of the teachers indicated a substantial and very substantial overlap.

Students' views were very much in agreement with the above findings. Again, about 80% of the students sampled noted that mathematics option includes topics from core mathematics only sometimes, very little of the time or never.

In summary, the majority of the students do get a mathematics option program which is different from the core mathematics program.

5. Extent of using community resources: It was considered important to utilize resources of the community and environment to demonstrate possible applications of mathematics.

Teacher responses indicated that the utilization of resources of the community and environment did not occur to a great deal. The response category "sometimes", "seldom", and "never" make up nearly 85% of the responses.

Of course, one has to keep in mind that some programs may not readily permit the use of resources from the community and environment.

6. The extent to which the curriculum provides for the needs, interests, and abilities of students: The implementation of mathematics option was to provide for the needs, interests, and abilities of the students. More than two-thirds of the teachers felt that they had met the challenge for most students. One-third of the teachers indicated that they provided for the needs, interests, and abilities of only some students.

7. The extent to which students could pursue individual programs:

Mathematics option was intended to enable students to explore their own growing interests and abilities with an emphasis on individualizing a student's program.

Students were asked whether they were allowed to work in areas of interest in mathematics option and the responses indicated a fairly large discrepancy between the intents and observations. A full 45% of the students claimed that they were allowed only "very little of the time" or "never" to work in areas of interest to them. Just under 40% of the students indicated having this opportunity only "sometimes".

8. Extent of structure in the mathematics option: Mathematics option was not intended to be structured by the Department of Education.

At the time it is still unstructured and it is the responsibility of the teachers who teach mathematics option to develop a curriculum for the course.

The intents and observations are completely congruent. It must be noted, however, that any structure that is found is that of the teacher, school or school board.

9. Continuation of Mathematics Option Program (Students' opinions):

From the data it was evident that the majority of the students (76.3%) would like the present program to be continued. Only about 16% were undecided and the remainder would like to see its abolition.

It may be said that mathematics option, as it exists, is favorably perceived by students.

MATERIALS AND FACILITIES

It was intended that mathematics option be offered only where resources permit.

The assessment of the availability of materials and facilities, by means of a questionnaire, was indeed a difficult task. The investigator had to assume that the items, which were being assessed, were important in the various mathematics option programs in Alberta.

In fact, it was assumed in CHAPTER III that four of the thirteen items assessed represented basic necessities in any mathematics option program. These four items were:

- Journals in Mathematics and Science
- Mathematics Reference Books (Other than Textbooks)
- Materials and Supplies for Projects (eg. construction paper, glue, wood, etc.)
- Mathematical Instruments such as: slide rules, protractors, parallel rules, compasses, calculating machines, etc.

Less than 20% of the teachers rated the availability of Journals in Mathematics and Science as "good" and "very good" combined. All others rated this item as "fair, "poor" or "non-existent".

The situation with Mathematics Reference Books was considered "satisfactory" or "better" by slightly less than one-third of the teachers.

Materials and Supplies for Projects were available to 63.1% of the teachers in sufficient amounts.

Only slightly less than one-third of the teachers indicated that the situation regarding Mathematical Instruments was satisfactory or better.

It can safely be concluded that if these materials and facilities are important in mathematics option, then the ratings they received from the teachers are fairly low. This would further imply that the intents and observations are incongruent.

The students supported the above conclusions in that only 51% of them felt they had always enough materials and facilities for projects in mathematics option.

Transaction Variables

Instructional Activities

1. Modes of instruction: It was intended to stress such modes as individualized instruction, library research, math-lab experiments as well as field trips and excursions.

It was found that pencil-paper activity was by far the most dominating instructional mode in mathematics option. Individual projects as a mode of instruction ranked in second position, however, far below pencil-paper activities.

The responses seemed to indicate that teachers were not using instructional modes that have been considered ideal or suitable for this type of program. In general, teachers have retained the traditional modes while only few new orientations have been adopted.

2. Grouping arrangements for mathematics option: Students were asked to indicate in what grouping arrangements they worked most frequently. About 42% of the students said that they worked by themselves most frequently and just over 36% indicated that they worked in small groups (2 or 3) most frequently.

No significant discrepancies were noted between the intents and observations regarding grouping arrangement.

3. Student evaluation in mathematics option: Students were to experience success in mathematics option which implied among many other things, downgrading marks.

Nearly 44% of the students reported that they were marked on the same basis as in regular mathematics and almost one-half claimed that their teacher used a different basis from regular mathematics for marking mathematics option. Of the students who claimed that their teacher used a different basis from regular mathematics for marking, only slightly over one-half indicated on what basis they were marked.

In summary, students were confused about how teachers evaluated them. This was not only shown by the lack of responses but also by the inconsistency of responses within the same groups.

From the responses it appeared that marks were used in mathematics option with considerable emphasis.

4. Fairness of evaluation: Despite the apparent confusion among students they still felt that their teacher's method of marking was fair. This was indicated by nearly 85% of the students.

Time Allotment

1. Instructional time per week: It was the intent to be flexible and, therefore, the proposed time range was from 75 to 175 minutes per week. The observations were quite congruent with the intent in that nearly 84% of the teachers used between two and four 40 minute periods per week.

Also, the majority of the students (72.3%) agreed that they had sufficient time for mathematics option each week.

2. Program lengths: Though it was not intended to be specific about program length, it was, however, suggested that modular scheduling for the options would be very useful.

The responses revealed that just over one-half of the teachers offer mathematics option as a full-year course. A semestered course was offered by 36.3% of the teachers. The suggestion that modular scheduling be used was almost totally ignored. Only 4.4% of the teachers had followed the suggestion.

OUTCOMES

General Objectives of Mathematics Option

1. Behavioral objectives: It was intended that students develop positive attitudes and a positive concept of self and others. To develop the ability to think critically and the mastery of basic skills were further intents of the mathematics option.

There was perfect agreement between intents and observations as far as the development of positive attitudes was concerned. To develop the students' ability to think critically and the mastery of basic mathematical skills ranked in position 4 and 13, respectively. Teachers considered the development of creative thinking in mathematics far more important than developing critical thinking and basic mathematical skills.

It can at least be said that, whatever the objectives were in the classrooms sampled, a full 79% of the students indicated that the objectives of their program were clear to them.

2. Effects of the program on the teachers: It was intended that teachers are free to innovate and develop their own mathematics option program. There existed little doubt that this was not the case.

It was also intended to improve the level of satisfaction among teachers who were only teaching according to a prescribed course outline. But, in order to understand the level of satisfaction among teachers, it was considered important to obtain additional information on aspects that may have had a strong influence on the teachers' disposition.

The amount of supervision required in mathematics option was one area. While 44.3% of the teachers agreed that students work well with little supervision in mathematics option, 35% of the teachers disagreed with that statement.

Another area was discipline in mathematics option. More than two-thirds of the teachers indicated that there were no more discipline problems in mathematics option than there were in core subjects. Only slightly under 20% of the teachers felt the opposite.

Preparation and planning in mathematics option did require more time than in other subjects. This was stated by 53.8% of the teachers. Only about one-quarter of the teachers (26.9%) did not think so.

Nearly 37% of the teachers indicated that there is greater mental and physical strain on teachers teaching core subjects. A full 45% disagreed with this statement.

The enrollment was found to be high. Just under one-half of the teachers reported enrollments of 26 students and more per class and for 21.9% of the teachers the enrollment was between 21 and 25 students.

In light of all the foregoing indicators, it can be said that the majority of the teachers (53.8%) were satisfied with the program and 13.1% even indicated that they were very satisfied. This seems to permit the conclusion that at least an adequate level of satisfaction has been achieved among teachers. Thus the intents and observations were at least moderately congruent.

Congruence of Observations with Standards

This section presents the analyses and discussion of results pertaining to questions 1, 2, and 3 of the congruence analysis section of CHAPTER III on page 45. Statistical procedures associated with the treatment of each question are discussed in conjunction with the results.

Antecedent Variables

Question 1: To what extent are the observed antecedents congruent to the antecedent standards with particular reference to the mathematics option teacher, mathematics option students, nature of mathematics option curriculum, and instructional materials and facilities?

The Mathematics Option Teacher: The congruence of responses to four questions were analyzed. These questions dealt with teaching experience, mathematics background, curriculum and instruction courses background, and selection of teachers to teach mathematics option.

A chi square test of independence was performed to provide a measure of the discrepancy between the observations and standards. These differences were considered significant at the .05 level or less.

TABLE 5.01 shows that no significant differences existed at the .05 level between the observed teaching experience of teachers in mathematics option and the standard for teaching experience in mathematics at the junior high school level. This permits the conclusion that the observed teaching experience in mathematics option is congruent to the established standard for teaching experience in mathematics at the junior high school level.

TABLE 5.01

DIFFERENCE BETWEEN THE OBSERVED TEACHING EXPERIENCE IN MATHEMATICS OPTION AND THE STANDARD FOR TEACHING EXPERIENCE AT THE JUNIOR HIGH SCHOOL LEVEL

(PERCENTAGE BY ROWS) N = 160

OBSERVED TEACHING EXPERIENCE	STANDARD FOR TEACHING EXPERIENCE					CHI SQUARE	df	p
	1	2	3	4	5			
1. NO EXPERIENCE	33.3	26.7	20.0	10.0	10.0			
2. 1YEAR	5.9	47.1	11.8	11.8	23.5			
3. 2 YEARS	28.6	34.3	20.0	11.4	5.7	22.0	16	.14
4. 3 YEARS	26.5	20.6	17.6	23.5	11.8			
5. MORE THAN 3 YEARS	13.6	18.2	36.4	18.2	13.6			

TABLE 5.02 shows that a significant difference existed at the .05 level between the observed mathematics background of teachers and the established standard for mathematics background. The incongruence was highly significant with a probability of much less than .05. Examination of the data indicated that the majority of the teachers (79.4%) selected either "1-3 courses" or "4-6 courses" as sufficient mathematics background regardless of the observed mathematics background.

TABLE 5.03 shows a significant difference between the observed background in curriculum and instruction courses and the established standard for curriculum and instruction courses for mathematics option teachers. Examination of the data indicated that, the teachers who reported to have no curriculum and instruction courses, only 20% felt that they needed none. The remaining 80% of the teachers in this category indicated that they should have ½ - 1 course (60%), 1½ - 2 courses (16.7%), and 2½ - 3 courses (3.3%). Fifty- eight percent of the teachers who responded to "½ - 1 course" also indicated that teachers should have ½ - 1 course in curriculum and instruction.

In general, the data, suggested that on the basis of the teachers' observed background they considered ½ - 1 course or 1½ - 2 courses sufficient background in curriculum and instruction courses in mathematics.

TABLE 5.02

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED MATHEMATICS BACKGROUND AND THE STANDARD FOR MATHEMATICS BACKGROUND OF MATHEMATICS OPTION TEACHERS

(PERCENTAGE BY ROWS) N = 160

OBSERVED MATHEMATICS BACKGROUND	STANDARD FOR MATHEMATICS BACKGROUND					CHI SQUARE	df	p
	1	2	3	4	5			
1. NONE	63.6	36.4	.0	.0	.0			
2. 1 - 3 COURSE(S)	16.3	67.4	16.3	.0	.0			
3. 4 - 6 COURSES	9.6	48.1	36.5	3.8	1.9	86.2	16	.00
4. 7 - 9 COURSES	2.5	17.5	67.5	12.5	.0			
5. MORE THAN 9	.0	28.6	35.7	21.4	14.3			

TABLE 5.03

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED BACKGROUND IN CURRICULUM AND INSTRUCTION COURSES AND THE STANDARD FOR BACKGROUND IN CURRUCULUM AND INSTRUCTION COURSES

(PERCENTAGE BY ROWS) N = 160

OBSERVED BACKGROUND IN ED. C. & I.	STANDARD FOR CURRICULUM AND INSTRUCTION BACKGROUND					CHI SQUARE	df	p
	1	2	3	4	5			
1. NONE	20.0	60.0	16.7	3.3	.0			
2. ½ - 1 COURSE	20.3	58.0	18.8	1.4	1.4			
3. 1½ - 2 COURSES	10.3	33.3	43.6	10.3	2.6	36.2	16	.003
4. 2½ - 3 COURSES	6.7	46.7	20.0	26.7	.0			
5. MORE THAN 3	.0	14.3	71.4	14.3	.0			

TABLE 5.04

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED SELECTION PROCEDURES FOR TEACHERS AND THE STANDARD FOR SELECTING TEACHERS TO TEACH MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

OBSERVED SELECTION PROCEDURE	STANDARD FOR SELECTION PROCEDURE						CHI SQUARE	df	p
	1	2	3	4	5	6			
1. ON THE BASIS OF TRAINING IN MATHEMATICS	42.9	23.8	4.8	.0	.0	28.6			
2. ON VOLUNTEER BASIS	7.1	85.7	.0	.0	.0	7.1			
3. ON THE BASIS OF TEACHING EXPERIENCE AT JUNIOR HIGH SCHOOL LEVEL	25.0	25.0	25.0	6.2	.0	18.8	85.6	25	.00
4. BY THE SCHOOL STAFF	25.0	50.0	25.0	.0	.0	.0			
5. BY THE PRINCIPAL	21.4	51.8	3.6	3.6	5.4	14.3			
6. OTHER: TEACHER/PRINCIPAL CONSULTATION, BASED ON 1 & 3	9.5	19.0	.0	4.8	.0	66.7			

TABLE 5.04 shows that the difference between the observed selection procedure for teachers and the standard for selection procedures is highly significant.

The incongruence of observed selection procedures and the standard for selection procedures was largely due to the discrepancy in the number of responses to three response categories. There were 26.2% of the teachers who described their selection to teach mathematics option as being one based on a voluntary basis. But 50% of the teachers indicated that it should be on a voluntary basis. Thirty-five percent of the teachers reported that they had been assigned by the principal. Only 1.9% of the teachers indicated that the principal should assign teachers to teach mathematics option. Differences also occured in the number of responses to the observed category "other" and the standard for that category. More teachers (21.2%) indicated that the assignment procedure should be one involving the principal, the teacher, the teacher's training in mathematics and his teaching experience at the junior high school level. At the present time only 13.1% of the teachers indicated that they use such a procedure.

The Mathematics Option Students

This section deals with the congruence of (1) the teachers' perception of what is and should be the selection procedure of students to the mathematics option, (2) the teachers' perception of what is and should be the grouping practice of students in mathematics option, (3) the teachers' perception of what mathematics option students' characteristics are and should be, (4) the teachers' perception of the differences as they are and should be, between mathematics option students and non-mathematics option students, and (5) the present view and the teachers' perception regarding the junior high school grade level at which mathematics option should be taught.

Chi square tests of independence were performed on the first four questions of this section. The congruence of the last question was determined by comparing the responses of the teachers to the present practice. The differences on the chi square tests were considered significant at the .05 level or less.

Examination of the data in TABLE 5.05 indicated that parents did not decide and should not decide whether or not their children enroll in mathematics option. It was further evident that on the basis of the teachers' observation they suggested that the selection of mathematics option should be the student's personal choice. At the present time 52.5% of the teachers observed that it was the student's personal choice to select mathematics option. When asked whose decision it should be, 77.5% of the teachers indicated that it should be the student's personal choice. Only 1.9% indicated that it was their decision to select students for mathematics option. Some 8% of the teachers felt that it should be their decision. The responses to all other categories decreased markedly from what teachers "observed" to what they felt "should be". In particular, 8.1% of the teachers observed that student enrollment in mathematicsoption was the administration's decision. Only .6% (or one teacher) felt that it should remain the administration's decision. Approximately 13% of the teachers reported that their

TABLE 5.05

SIGNIFICANT DIFFERENCE BETWEEN THE TEACHERS' PERCEPTION OF THE OBSERVED SELECTION PROCEDURES FOR STUDENTS AND THE STANDARD FOR SELECTING STUDENTS TO TAKE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

OBSERVED SELECTION PROCEDURE	STANDARD FOR SELECTION PROCEDURE						CHI SQUARE	df	p
	1	2	3	4	5	6			
1. PERSONAL CHOICE	84.5	8.3	1.2	-	.0	6.0			
2. THE TEACHER'S DECISION	33.3	66.7	.0	-	.0	.0			
3. ADMINISTRATION'S DECISION (eg. PRINCIPAL, COUNSELLOR)	84.6	.0	.0	-	.0	15.4	34.3	16	.005
4. PARENT'S DECISION	-	-	-	-	-	-			
5. COURSE BEING COMPULSORY	71.4	9.5	.0	-	4.0	14.3			
6. OTHER: COMBINATION OF 1, 2, & 3	66.7	5.1	.0	-	.0	28.2			

mathematics option course is compulsory. Again, only one teacher (.6%) said that it should remain compulsory.

One additional response category was determined under "other", involving the student, teacher and administration in the selection procedure of students for mathematics option.

The incongruence of the observed selection procedures with the standard is largely due to the fact that regardless of what teachers presently observe the majority indicated that it should be the students' personal choice.

TABLE 5.06 shows a significant difference between the observed grouping practices of students in mathematics option and the standard for grouping practices. There were 17.5% of the teachers who described their mathematics option classes as being homogeneous with respect to mathematical ability, but 58.8% felt that mathematics option classes should be grouped homogeneously with respect to mathematical ability.

Among the teachers, who reported that they grouped homogeneously, 85.7% indicated that the grouping of students for mathematics option should be homogeneous with respect to mathematical ability. The majority of the teachers reported that they grouped heterogeneously but 53% of these teachers indicated that the students should be grouped homogeneously with respect to mathematical ability.

In general, the data indicated that heterogeneous grouping was predominant but the teachers would prefer to use homogeneous grouping of students in mathematics option.

TABLE 5.06

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED GROUPING PRACTICES AND THE STANDARD FOR GROUPING PRACTICES

(PERCENTAGE BY ROWS) N = 160

OBSERVED GROUPING PRACTICES	STANDARD FOR GROUPING PRACTICES		CHI SQUARE	df	p
	1	2			
1. HOMOGENEOUS WITH RESPECT TO MATHEMATICAL ABILITY	85.7	14.3	10.2	1	.001
2. HETEROGENEOUS WITH RESPECT TO MATHEMATICAL ABILITY	53.0	47.0			

TABLE 5.07 shows significant differences between the observed characteristics of mathematics option students and the established standards for these characteristics. Teachers tended to prefer students with positive attitudes toward mathematics rather than students with high mathematical ability.

TABLE 5.08 shows that significant differences existed between the teachers' observations and standard of differences between mathematics option students and non-mathematics option students.

Of the teachers who indicated that mathematics option students have better attitudes, the majority (63.5%) felt that they should have better attitudes.

Of the teachers who observed that mathematics option students have greater ability in mathematics, 50% of them advocated that they should have better attitudes.

Of the teachers who described mathematics option students as being more creative, 57.1% indicated that they should be more creative. But again, 42.9% of the teachers in this category felt that mathematics option students should have better attitudes.

Another group of teachers indicated that there were no differences between mathematics option students and non-mathematics option students in mathematical ability and/or attitudes. However, the majority of the teachers (50.8%) of this group felt that mathematics option students should have better attitudes.

The incongruence of observations and standards is largely due to the fact that teachers observe all kinds of differences between mathematics option students and non-mathematics option students but they prefer that mathematics option students have better attitudes toward mathematics.

TABLE 5.07

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED STUDENT CHARACTERISTICS AND THE STANDARD FOR STUDENT CHARACTERISTICS

(PERCENTAGE BY ROWS) N = 160

OBSERVED STUDENT CHARACTERISTICS	STANDARD FOR STUDENT CHARACTERISTICS				CHI SQUARE	df	p
	1	2	3	4			
1. STUDENTS REQUIRING REMEDIAL HELP IN MATHEMATICS	41.4	3.4	41.4	13.8			
2. STUDENTS WITH HIGH MATHEMATICAL ABILITY	12.5	12.5	25.0	50.0	58.6	9	.00
3. STUDENTS WITH POSITIVE ATTITUDES TOWARD MATHEMATICS	2.2	4.3	89.1	4.3			
4. OTHER: COMBINATION OF 1, 2, & 3	2.6	9.1	61.0	27.3			

TABLE 5.08

SIGNIFICANT DIFFERENCE BETWEEN THE TEACHERS' PERCEPTION OF THE DIFFERENCE OF MATHEMATICS OPTION STUDENTS (MOS) IN RELATION TO NON-MATHEMATICS OPTION STUDENTS (NMOS) AND THE STANDARD FOR THIS DIFFERENCE BETWEEN THE TWO GROUPS

(PERCENTAGE BY ROWS) N = 160

OBSERVED DIFFERENCE BETWEEN MOS AND NMOS	STANDARD FOR THE DIFFERENCE BETWEEN MOS and NMOS					CHI SQUARE	df	p
	1	2	3	4	5			
1. MOS HAVE BETTER ATTITUDES TOWARD MATHEMATICS	63.5	9.6	11.5	7.7	7.7	53.9	16	.00
2. MOS HAVE GREATER ABILITY IN MATHEMATICS	50.0	25.0	12.5	12.5	.0			
3. MOS ARE MORE CREATIVE IN MATHEMATICS	42.9	.0	57.1	.0	.0			
4. NO DIFFERENCE BETWEEN MOS AND NMOS IN MATHEMATICAL ABILITY AND/OR ATTITUDES	50.8	6.6	3.3	27.9	11.5			
5. OTHER: COMBINATION OF 1, 2, & 3	28.1	6.2	12.5	12.5	40.6			

The congruence of the observed grade level with what teachers felt should be the grade level at which mathematics option is taught was also of interest.

Of course, the observation is that mathematics option is offered at all three junior high school grade levels. The grade levels at which it should be taught are shown in TABLE 4.47 of CHAPTER 1V on page 128. The data indicated that teachers would want to continue to offer mathematics option at all three grade levels in junior high school. This was expressed by 81.3% of the teachers. Although other alternatives were suggested, the number of teachers in the other categories were relatively small in number.

The Nature of the Mathematics Option Curriculum

This section deals with the congruence of observations and standards of five questions related to the mathematics option curriculum. The questions of interest deal with (1) the types of mathematics option programs, (2) the extent to which students contribute to the selection of curricular content in mathematics option, (3) the ways students help to structure the mathematics option program, (4) the amount of overlap of mathematics option content with regular mathematics content, and (5) the extent to which resources of the community and environment are included to demonstrate applications of mathematics.

The congruence of observations and standards was determined using chi square tests of independence. Differences between observations and standards were considered significant at the .05 level or less.

TABLE 5.09 reveals that significant differences existed between the observed types of mathematics option programs and the standard for the types of mathematics option programs.

From the data in CHAPTER 1V one can observe three large discrepancies. From the teachers (16.9%) who offered a remedial course, only 6.9% felt that it should be a remedial course. Teachers who offered a general interest course also reduced drastically. Forty percent had offered this type of course but only 23.1% felt that it should be offered.

A course that provided for individual interest and abilities was offered by 12.5% of the teachers, but 34.4% felt that this type of course should be offered.

TABLE 5.10 shows that significant differences existed between the teachers' perception of the extent to which students do and should contribute to the selection of curriculum content in mathematics option.

All teachers who observed that students contribute to a great extent to the selection of curriculum content also felt that they should be contributing to a great extent.

Of the teachers who indicated that their students contributed to some extent, 75.9% felt that it should be to some extent and 24.1% chose to a great extent.

In summary, the percentages went up significantly for the first two response categories from the observations to the reported standards. A marked decrease was noticed for the last two response categories from the observations to the standards.

TABLE 5.09

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED TYPES OF MATHEMATICS OPTION PROGRAMS AND THE STANDARD FOR THE TYPE OF MATHEMATICS OPTION PROGRAMS

(PERCENTAGE BY ROWS) N = 160

OBSERVED TYPES OF MATH. OPTION PROGRAMS	STANDARDS FOR TYPES OF MATH. OPTION PROGRAMS 1	2	3	4	5	CHI SQUARE	df	P
1. REMEDIAL COURSE FOR STUDENTS WITH PROBLEMS IN REGULAR MATHEMATICS	25.9	.0	14.8	33.3	25.9	116.0	16	.00
2. ENRICHMENT COURSE	5.9	61.8	5.9	14.7	11.8			
3. GENERAL INTEREST COURSE	1.6	6.2	43.8	34.4	14.1			
4. PROVIDING FOR INDIVIDUAL INTERESTS AND ABILITIES	.0	.0	10.0	80.0	10.0			
5. OTHERS: COMBINATION OF 2 AND 3 COMBINATION OF 1 AND 3 COMBINATION OF 1 AND 4	6.7	20.0	6.7	20.0	46.7			

TABLE 5.10

SIGNIFICANT DIFFERENCE BETWEEN THE TEACHERS' PERCEPTION OF THE EXTENT TO WHICH STUDENTS DO AND SHOULD CONTRIBUTE TO THE SELECTION OF CURRICULAR CONTENT IN MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

OBSERVED STUDENT CONTRIBUTION TO MATH. OPTION CURRICULUM	STANDARD FOR STUDENT CONTRIBUTION				CHI SQUARE	df	p
	1	2	3	4			
1. TO A GREAT EXTENT	100.0	.0	.0	.0	74.2	9	.00
2. TO SOME EXTENT	24.1	75.9	.0	.0			
3. TO A VERY LITTLE EXTENT	14.5	63.6	20.0	1.8			
4. NOT AT ALL	26.7	40.0	13.3	20.0			

TABLE 5.11 shows that a significant difference existed at the .05 level between the teachers' perception of how students do and should help to structure the mathematics option program. The incongruence was highly significant with a probability of much less than .05.

Examination of the data revealed that only 5.6% of the teachers observed that the suggestions of each student were being used to plan an individual program for that student. However, 31.3% felt that this should be the way by which students help structure the mathematics option program.

TABLE 5.12 shows that a significant difference existed at the .05 level between the observed content overlap and the standard for content overlap of mathematics option with regular mathematics.

Of those teachers who indicated that the content of their mathematics option program overlapped moderately, the majority (63.1%) felt that it should overlap moderately. Similarily, of the teachers who reported little overlap, nearly 80% indicated that the overlap should be as little as possible. From TABLES 4.15 and 4.51, it can be seen that relatively few teachers responded to categories 1 and 2. Of those teachers who did respond to these categories a fairly large proportion felt that the overlap should be moderate or as little as possible.

TABLE 5.11

SIGNIFICANT DIFFERENCE BETWEEN THE TEACHERS' PERCEPTION OF HOW STUDENTS DO AND HOW THEY SHOULD HELP TO STRUCTURE THE MATHEMATICS OPTION PROGRAM

(PERCENTAGE BY ROWS) N = 160

OBSERVED STUDENT HELP	STANDARD FOR STUDENT HELP					CHI SQUARE	df	p
	1	2	3	4	5			
1. BY WAY OF SUGGESTING ACTIVITIES WHICH ARE THEN USED TO ORGANIZE A PROGRAM FOR THE WHOLE CLASS	57.4	29.8	2.1	2.1	8.5			
2. EACH STUDENT SUBMITS SUGGESTIONS WHICH ARE THEN USED TO PLAN AN INDIVIDUAL PROGRAM FOR THAT STUDENT	22.2	66.7	11.1	.0	.0			
3. STUDENTS SELECT ACTIVITIES FROM A POOL OF SUGGESTIONS SUBMITTED BY THE TEACHER	12.8	29.8	51.1	4.3	2.1	105.9	16	.00
4. THE LIMITED BACKGROUND DOES NOT PERMIT THE STUDENTS TO HELP	13.9	22.2	13.9	41.7	8.3			
5. OTHER: JOINT EFFORT OF STUDENTS AND TEACHER	19.0	38.1	9.5	4.8	28.6			

TABLE 5.12

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED CONTENT OVERLAP AND THE STANDARD FOR CONTENT OVERLAP OF MATHEMATICS OPTION WITH REGULAR MATHEMATICS

(PERCENTAGE BY ROWS) N = 160

OBSERVED CONTENT OVERLAP	STANDARD FOR CONTENT OVERLAP				CHI SQUARE	df	p
	1	2	3	4			
1. VERY SUBSTANTIAL	40.0	30.0	20.0	10.0	111.0	9	.00
2. SUBSTANTIAL	13.3	40.0	40.0	6.7			
3. MODERATE	.0	15.4	63.1	21.5			
4. AS LITTLE AS POSSIBLE	.0	4.3	17.1	78.6			

TABLE 5.13 shows that significant differences existed at the .05 level between the observed use of community resources and the standard for using community resources in mathematics option. The incongruence is largely due to discrepancies in the "frequently" category. While 15% of the teachers reported to have made frequent use of resources in the community and environment, 61.9% felt that these resources should be frequently used. There were 36.3% of the teachers who were seldomly using resources of the community and environment. Only one teacher indicated that these resources should seldomly be used.

It appears that, regardless of what teachers presently observe, the majority indicated a definite trend toward the categories "frequently" and "most of the time".

TABLE 5.13

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED USE OF COMMUNITY RESOURCES AND THE STANDARD FOR USING COMMUNITY RESOURCES IN MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

OBSERVED USE OF COMMUNITY RESOURCES	STANDARD FOR USING COMMUNITY RESOURCES					CHI SQUARE	df	p
	1	2	3	4	5			
1. MOST OF THE TIME	100.0	.0	.0	.0	.0	79.7	12	.00
2. FREQUENTLY	12.5	87.5	.0	.0	.0			
3. SOMETIMES	.0	74.1	25.9	.0	.0			
4. SELDOM	3.4	51.7	43.1	1.7	.0			
5. NEVER	.0	27.8	72.2	.0	.0			

Materials and Facilities

The adequacy of materials and facilities was judged by the teachers. Thirteen items were listed and each item was rated from 1 - 6. A rating of (1) indicated "not desirable to have", (2) "not applicable" or "non-existent", (3) "poor, should be improved", (4) "fair, needs attention", (5) "good, satisfactory", and (6) "very good, highly effective".

TABLE 4.22 shows the distribution of teacher responses to the ratings of materials and facilities.

TABLE 5.14 shows the percentages of the "good" and "very good" categories as well as their combined total for each of the items. From TABLE 5.14 one can see that none of the totals were congruent with the standard established by the investigator. The items 41, 42, 49, and 50, which were considered basic necessities in any mathematics option program, received relatively low ratings. Item 49, materials and supplies for projects, was found to be "good" or "very good" by 63.1% of the teachers. Nearly one half of the teachers rated the adequacy of mathematical games and puzzles as "good" or "very good". The percentages to all other items were extremely low.

Only one-half of the mathematics option students of the eleven schools indicated that they always had enough materials and facilities for projects in mathematics option.

The data provided clear evidence that the standard of 75%, in the "good" and "very good" categories combined, was not achieved for the basic items nor for any of the thirteen items listed in TABLE 5.14.

TABLE 5.14

FREQUENCY OF RESPONSES OF MATERIALS AND FACILITIES BEING "GOOD" OR "VERY GOOD"

N = 160

NO.	ITEM	PERCENTAGE RESPONSES G*	VG**	TOTAL
38.	MATHEMATICS LABORATORY	11.2	.6	11.8
39.	STORAGE FACILITIES FOR SUPPLIES AND EQUIPMENT	24.4	3.7	28.1
40.	LIBRARY	31.3	4.4	35.7
41.	JOURNALS IN MATHEMATICS AND SCIENCE	18.8	.6	19.4
42.	MATHEMATICS REFERENCE BOOKS (OTHER THAN TEXTBOOKS)	26.9	4.4	31.3
43.	INDIVIDUAL LEARNING PACKAGES (UNIPAKS)	10.0	4.4	14.4
44.	TEACHER-PREPARED MATERIALS, SUCH AS PROJECT OUTLINES, GUIDES, ETC.	23.8	5.6	29.4
45.	MATHEMATICS GAMES AND PUZZLES	33.7	13.1	46.8
46.	VISUAL AIDS SUCH AS: GRAPHS, DIAGRAMS, CHARTS, AND MODELS	19.4	3.1	22.5
47.	MATHEMATICS FILMS AND VIDEO-TAPES	5.0	1.9	6.9
48.	FILMSTRIPS AND SLIDES IN MATHEMATICS	8.7	1.2	9.9
49.	MATERIALS AND SUPPLIES FOR PROJECTS (eg. CONSTRUCTION PAPER AND OTHER TYPES, GLUE, WOOD, ETC.)	55.0	8.1	63.1
50.	MATHEMATICAL INSTRUMENTS SUCH AS: SLIDE RULES, PROTRACTORS, PARALLEL RULES, COMPASSES, CALCULATING MACHINE, ETC.	26.2	5.0	31.2

*G = GOOD, SATISFACTORY
**VG = VERY GOOD, HIGHLY EFFECTIVE

The investigator found much evidence that schools were developing or acquiring fairly well-suited materials for mathematics option, but the fact remains that this is a slow process. In many instances it was a financial problem and in others it was a question of time.

Clearly, the mathematics option program is very dependent for its success upon a variety of learning materials of many forms. Unless such materials are available and the existing resources improved in many schools, the program will fail to be successful.

Transaction Variables

Question 2: To what extent are the observed transactions congruent to the standards of transaction, with particular reference to instructional activities and time allocation?

Instructional Activities: Eighteen different instructional modes were ranked by the teachers according to their frequency of use in mathematics option. The observed frequencies are shown in TABLE 4.24 and the preferred frequencies in TABLE 4.54. The investigator decided arbitrarily to consider a difference of five or more ranks an important difference.

Although fairly large differences in the percentage responses occurred between observations and standards, only three instructional modes showed an important difference in rank (See TABLE 5.15).

"Teacher demonstrations" as an instructional mode ranked fourth as observed but it was felt that it should have ranked eleventh. "Math-lab experiments" were observed to be in the tenth position but teachers felt that it should have ranked in the second position. Another important difference occurred on "teacher lectures" as an instructional mode. Its importance in the classroom was lowered from rank twelve to rank eighteen.

The incongruence of instructional activities between observations and standard is not so much due to the difference in relative rank position of each activity but rather to the large differences that occurred between observations and standards for each instructional activity.

In summary, it can be said that while teachers still make too much use of the "traditional" methods, the majority felt that individual projects, math-lab experiments and small group discussions should be dominating in the mathematics option classroom.

TABLE 5.15

RANK ORDER OF INSTRUCTIONAL ACTIVITIES AS THEY WERE USED AND SHOULD BE USED IN MATHEMATICS OPTION. (AS PER TABLES 4.24 AND 4.54)

N = 160

INSTRUCTIONAL ACTIVITIES	OBSERVED		STANDARD		DIFFERENCE
	%	RANK	%	RANK	
PENCIL-PAPER ACTIVITIES	63.8	1	49.4	5	4
INDIVIDUAL PROJECTS	36.9	2	72.6	1	1
CLASS DISCUSSIONS	31.8	3	51.2	4	1
TEACHER DEMONSTRATION	31.2	4	26.2	11	7
MATHEMATICAL GAME APPROACH	29.9	5	44.4	7	2
SMALL GROUP DISCUSSION	29.3	6	53.1	3	3
SMALL GROUP PROJECTS	26.2	7	45.0	6	1
DRILL PRACTICE	24.3	8	25.7	12	4
INDIVIDUAL TEACHER/STUDENT CONFERENCES	23.1	9	43.8	8	1
MATH-LAB EXPERIMENTS	17.4	10	59.4	2	8
CLASS PROJECTS	16.9	11	21.9	15	4
TEACHER LECTURE	15.6	12	5.0	18	6
LIBRARY RESEARCH	9.3	13.5	37.5	9	4.5
INDIVIDUAL LEARNING PACKAGES (UNIPAKS)	9.3	13.5	28.7	10	3.5
STUDENT DIRECTED CLASS DISCUSSIONS	8.8	15	23.1	14	1
FIELD TRIPS AND EXCURSIONS	3.1	16	25.0	13	3
RESOURCE PERSONS FROM COMMUNITY	1.9	17.5	20.6	17	.5
FILMS, SLIDES, AND FILMSTRIPS	1.9	17.5	21.2	16	1.5

Time Allocation: In this section the focus was on two aspects -- the time allocated to mathematics option and the length of the various programs.

The observations and standards are fairly congruent as far as the amount of time is concerned. The majority of the teachers were using 2 to 3 forty minute periods per week and they also felt that this should be the amount of time allotted to mathematics option. Of the mathematics option students participating in this study, the majority supported this. More than 70% of the students indicated that they had sufficient time in mathematics option.

Significant differences were observed at the .05 level between the observed program length and the standard for program length (See TABLE 5.16).

It was observed that more than one-half of the teachers offered mathematics option as a full-year course. In general, it was found that there is a trend away from offering mathematics option as a full-year course. Semestered courses were preferred by the majority of the teachers.

Trimestering the course and modular scheduling were used by small groups of teachers. Only a few of the teachers showed a preference for such short courses. The reason for the lack of responses to these two categories could well have been the teachers' awareness of the increased difficulties in time tabling at the school level.

TABLE 5.16

SIGNIFICANT DIFFERENCE BETWEEN THE OBSERVED LENGTH OF THE MATHEMATICS OPTION PROGRAM AND THE STANDARD FOR PROGRAM LENGTH IN MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

OBSERVED PROGRAM LENGTH	STANDARD FOR PROGRAM LENGTH IN MATH. OPTION				CHI SQUARE	df	p
	1	2	3	4			
1. FULL YEAR COURSE	53.1	40.7	2.5	3.7			
2. SEMESTERED COURSE	3.4	75.9	10.3	10.3			
3. TRIMESTERED COURSE	.0	.0	85.7	14.3	139.0	9	.00
4. OTHER: MODULAR ORGANIZATION	14.3	28.6	.0	57.1			

Outcome Variables

Question 3: To what extent are the observed outcomes congruent to the standards of outcomes, with particular reference to students' attitude, creative ability in mathematics, and the effect of the program on teachers?

Although students' attitude and their creative ability in mathematics are part of the above question, a detailed discussion by school is presented in CHAPTER VII. In order to reduce the complexity of this section, it was decided to deal with the effects of the program on teachers only.

Effect of the Program on Teachers: There were five areas of interest: (1) the amount of supervision required in mathematics option, (2) discipline problems in mathematics option as compared to core subjects, (3) preparation and planning time in mathematics option as compared to core subjects, (4) the amount of mental and physical strain on teachers teaching mathematics option as compared to teachers teaching core subjects and (5) the enrollment in mathematics option classes.

The observations in these five areas were provided by the teachers, while the standards were established by the investigator.

From TABLE 4.33 it was evident that less than one-half of the teachers agreed that students work well with little supervision in mathematics option. The investigator argued, that in light of the philosophy and original intent of the option, students should work well with little supervision in mathematics option. Hence, it must be argued that observations and standards are at most moderately congruent.

TABLE 4.34 shows that only about 19% of the teachers indicated that there were more discipline problems in the mathematics option than in core subjects. The majority of the teachers disagreed with this statement. Again, the investigator's standard reads that there should be fewer discipline problems in mathematics option than in core subjects. Here, the observations and standard can be considered fairly congruent.

The data in TABLE 4.35 indicate that more than one-half of the teachers require more time for lesson preparation and planning in mathematics option than in other subjects. This was expressed by the investigator as a standard. Thus, in this area existed moderate agreement between observations and standard.

A far greater discrepancy existed between observations and standard regarding the amount of mental and physical strain on mathematics option teachers as compared to teachers in core subjects. Only 37% of the teachers felt that they were subject to greater mental and physical strain in mathematics option than in core subjects. Here, the investigator had argued that due to the intended nature of the option program, teachers in mathematics option would likely experience greater mental and physical strain than core subject teachers.

Although the observations and standard are incongruent, it must not be over looked that more than one-third of the mathematics option teachers experience greater mental and physical strain than core subject teachers.

Enrollments in mathematics option classes should not exceed twenty-five students. This was considered a reasonable standard for this type of course. The observations revealed, however, that nearly 50% of the teachers reported enrollments of 26 and more students. The observed enrollments are far from being desirable for this type of course and the degree of congruence can hardly be considered moderate.

CHAPTER VI

CONTINGENCY ANALYSIS

Introduction

One of the purposes of this study was to determine whether any significant relationships existed between a number of observed variables. The relationships that were of interest are stated in CHAPTER III, null hypotheses 1 to 8. Each of these null hypotheses is restated below and a decision regarding each null hypothesis follows together with statistical evidence.

Chi square tests of independence were performed to determine whether significant relationships existed between two categories of data variables. These relationships were considered as being significant at the .05 level or less.

Null Hypothesis 1

> There is no significant relationship between the professional background of mathematics option teachers and their level of satisfaction in teaching the mathematics option (See questions 5. 6, and III of MOTQ).

In order to test this hypothesis two relationships had to be examined. One was the relationship of teaching experience at the junior high school level with the level of satisfaction in teaching mathematics option.

TABLE 6.01 indicates that there is no significant relationship at the .05 level between teaching experience at the junior high school level and the level of satisfaction of teachers teaching mathematics option. Thus, the more experienced teacher will not necessarily be more satisfied in teaching mathematics option.

The relationship of teaching experience in mathematics option and the level of satisfaction of teachers teaching mathematics option was the other relationship of interest. The results are shown in TABLE 6.02. Again, there is no significant relationship at the .05 level. It appears that teachers do not increase their level of satisfaction in mathematics option by teaching it from year to year.

On the basis of these findings, the null hypothesis is therefore not rejected.

TABLE 6.01

RELATIONSHIP BETWEEN THE TEACHING EXPERIENCE OF TEACHERS AT THE JUNIOR HIGH SCHOOL LEVEL AND THEIR LEVEL OF SATISFACTION IN TEACHING THE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

TEACHING EXPERIENCE AT JUNIOR HIGH LEVEL	LEVEL OF SATISFACTION					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NO EXPERIENCE	10.0	50.0	.0	40.0	.0			
1 YEAR	14.3	42.9	.0	14.3	28.6			
2 YEARS	13.3	53.3	13.3	20.0	.0	17.2	16	.37
3 YEARS	.0	61.5	15.4	23.1	.0			
MORE THAN 3 YEARS	14.8	53.9	7.0	19.1	5.2			

NOTE: 1* - VERY SATISFIED
2* - GENERALLY SATISFIED
3* - UNDECIDED
4* - SOMEWHAT DISSATISFIED
5* - VERY DISSATISFIED

TABLE 6.02

RELATIONSHIP BETWEEN TEACHING EXPERIENCE IN MATHEMATICS OPTION AND LEVEL OF SATISFACTION OF TEACHERS IN TEACHING MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

TEACHING EXPERIENCE IN MATH. OPTION	LEVEL OF SATISFACTION					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NO EXPERIENCE	6.7	46.7	6.7	30.0	10.0			
1 YEAR	5.9	47.1	23.5	17.6	5.9			
2 YEARS	14.3	57.1	5.7	22.9	.0	16.6	16	.41
3 YEARS	17.6	50.0	8.8	17.6	5.9			
MORE THAN 3 YEARS	15.9	61.4	2.3	15.9	4.5			

NOTE: 1* - VERY SATISFIED
2* - GENERALLY SATISFIED
3* - UNDECIDED
4* - SOMEWHAT DISSATISFIED
5* - VERY DISSATISFIED

Null Hypothesis 2

> There is no significant relationship between the academic background of mathematics option teachers and their level of satisfaction in teaching the mathematics option. (See question 8, 10 and III of MOTQ).

The test of this hypothesis required the examination of two relationships. The relationship of the number of mathematics courses with the level of satisfaction of teachers teaching mathematics option was explored first. TABLE 6.03 indicates that there was no significant relationship at the .05 level. Teachers with few or no mathematics courses were just as satisfied as teachers with a large number of mathematics courses.

TABLE 6.04 shows the relationship between the number of curriculum and instruction courses in mathematics and the level of satisfaction of teachers teaching mathematics option. Although there was no significant relationship, however, the data tend to suggest that an increase in the number of curriculum and instruction courses will increase the level of satisfaction.

Null hypothesis 2, however, can not be rejected.

TABLE 6.03

RELATIONSHIP BETWEEN THE NUMBER OF MATHEMATICS COURSES AND THE LEVEL OF SATISFACTION OF TEACHERS IN TEACHING MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

NUMBER OF MATHEMATICS COURSES	LEVEL OF SATISFACTION					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NONE	.0	63.6	9.1	27.3	.0			
1 - 3 COURSE(S)	16.3	46.5	9.3	23.3	4.7			
4 - 6 COURSES	5.8	53.8	5.8	26.9	7.7	16.8	16	.40
7 - 9 COURSES	20.0	65.0	5.0	7.5	2.5			
MORE THAN 9	21.4	35.7	14.3	21.4	7.1			

NOTE: 1* - VERY SATISFIED
2* - GENERALLY SATISFIED
3* - UNDECIDED
4* - SOMEWHAT DISSATISFIED
5* - VERY DISSATISFIED

TABLE 6.04

RELATIONSHIP BETWEEN THE NUMBER OF CURRICULUM AND INSTRUCTION COURSES (ED. CI.) IN MATHEMATICS AND THE LEVEL OF SATISFACTION OF TEACHERS IN TEACHING MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

NUMBER OF ED. CI. COURSES	LEVEL OF SATISFACTION					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NONE	3.3	50.0	10.0	33.3	3.3			
½ - 1 COURSE	10.1	56.5	7.2	20.3	5.8			
1½ - 2 COURSES	17.9	53.8	10.3	12.8	5.1	22.2	16	.14
2½ - 3 COURSES	13.3	53.3	.0	26.7	6.7			
MORE THAN 3	57.1	42.9	.0	.0	.0			

NOTE: 1* - VERY SATISFIED
2* - GENERALLY SATISFIED
3* - UNDECIDED
4* - SOMEWHAT DISSATISFIED
5* - VERY DISSATISFIED

Null Hypothesis 3

> There is no significant relationship between the mathematics background of mathematics option teachers and their assignment to teach the mathematics option. (See questions 8 and 12 of MOTQ).

A significant relationship existed at the .05 level between the mathematics background of teachers and their assignment to teach mathematics option (See TABLE 6.05). The assignment of teachers by the principal, through teacher/principal consultation or on the voluntary basis account for a large percentage in each of the categories. The assignment of teachers on the basis of training in mathematics and on the basis of teaching experience at the junior high school showed a definite relationship with the number of mathematics courses. As the number of mathematics courses increased, so did the number of teachers assigned on the basis of training in mathematics. Exactly the reverse occurred with the assignment of teachers on the basis of teaching experience at junior high school level. Those teachers who had no mathematics background were chosen mostly on the basis of teaching experience. The number of teachers thus chosen decreased as the number of mathematics courses increased. None of the teachers with more than 9 mathematics courses was chosen on the basis of teaching experience at the junior high school level.

The null hypothesis is therefore not rejected.

TABLE 6.05

SIGNIFICANT RELATIONSHIP BETWEEN THE MATHEMATICS BACKGROUND OF TEACHERS AND THEIR ASSIGNMENT TO TEACH THE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

NUMBER OF MATH. COURSES	ASSIGNMENT PROCEDURE OF TEACHERS						CHI SQUARE	df	P
	1*	2*	3*	4*	5*	6*			
NONE	.0	9.1	27.3	.0	27.3	36.4			
1 - 3 COURSE(S)	4.7	30.2	14.0	.0	37.2	14.0			
4 - 6 COURSES	13.5	26.9	9.6	7.7	36.5	5.8	32.6	20	.04
7 - 9 COURSES	20.0	27.5	5.0	.0	30.0	17.5			
MORE THAN 9	28.6	21.4	.0	.0	42.9	7.1			

NOTE: 1* - ON BASIS OF TRAINING IN MATHEMATICS
2* - ON VOLUNTEER BASIS
3* - ON BASIS OF TEACHING EXPERIENCE AT JUNIOR HIGH SCHOOL
4* - BY SCHOOL STAFF
5* - BY PRINCIPAL
6* - TEACHER/PRINCIPAL CONSULTATION

Null Hypothesis 4

> There is no significant relationship between the professional background and the ability to develop a curriculum in the mathematics option. (See questions 5, 6, and 36 of MOTQ).

The development of a curriculum in mathematics option was the teachers' responsibility. It was, therefore, of some interest to study the relationship of teaching experience in mathematics option and teaching experience at the junior high school level to the degree of difficulty in developing a mathematics option curriculum.

The data in TABLE 6.06 and TABLE 6.07 reveal that no significant relationships exist and the null hypothesis is therefore not rejected.

The results seem to suggest that in the judgment of the teachers neither teaching experience in mathematics option nor teaching experience at junior high school level has a significant influence on the degree of difficulty in developing a mathematics option curriculum.

TABLE 6.06

RELATIONSHIP BETWEEN THE TEACHING EXPERIENCE OF TEACHERS AT THE JUNIOR HIGH SCHOOL LEVEL AND THEIR JUDGMENT OF THE DIFFICULTY OF DEVELOPING A CURRICULUM IN THE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

TEACHING EXPERIENCE AT JUNIOR HIGH SCHOOL LEVEL	DIFFICULTY OF DEVELOPING A MATH. OPTION CURRICULUM					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NO EXPERIENCE	10.0	40.0	40.0	10.0	.0			
1 YEAR	.0	14.3	85.7	.0	.0			
2 YEARS	6.7	40.0	40.0	13.3	.0	8.9	12	.71
3 YEARS	7.7	38.5	30.8	23.1	.0			
MORE THAN 3	2.6	38.3	46.1	13.0	.0			

NOTE: 1* - VERY EASY TASK
2* - NO MORE DIFFICULT THAN PLANNING FOR OTHER SUBJECTS
3* - MORE DIFFICULT THAN OTHER SUBJECTS
4* - VERY DIFFICULT TASK
5* - BEYOND MY ABILITY

TABLE 6.07

RELATIONSHIP BETWEEN THE TEACHING EXPERIENCE OF TEACHERS IN MATHEMATICS OPTION AND THEIR JUDGMENT OF THE DIFFICULTY OF DEVELOPING A CURRICULUM IN THE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

TEACHING EXPERIENCE IN MATH. OPTION	DIFFICULTY OF DEVELOPING A MATH. OPTION CURRICULUM					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NO EXPERIENCE	3.3	30.0	56.7	10.0	.0			
1 YEAR	.0	29.4	58.8	11.8	.0			
2 YEARS	5.7	48.6	28.6	17.1	.0	9.0	12	.71
3 YEARS	2.9	44.1	44.1	8.8	.0			
MORE THAN 3	4.5	31.8	47.7	15.9	.0			

NOTE: 1* - VERY EASY TASK
2* - NO MORE DIFFICULT THAN PLANNING FOR OTHER SUBJECTS
3* - MORE DIFFICULT THAN OTHER SUBJECTS
4* - VERY DIFFICULT TASK
5* - BEYOND MY ABILITY

Null Hypothesis 5

> There is no significant relationship between the academic background and the ability to develop a curriculum in the mathematics option. (See questions 8, 10 and 36 of MOTQ).

The relationship of the number of mathematics courses and curriculum and instruction courses in mathematics to the degree of difficulty in developing a mathematics option curriculum was the content of null hypothesis 5. There was no significant relationship in both instances and the null hypothesis was therefore not rejected. The results are shown in TABLE 6.08 and TABLE 6.09. It is evident that neither the number of mathematics courses nor the number of curriculum and instruction courses in mathematics will make a significant difference on how teachers judge their difficulties in developing a mathematics option curriculum.

TABLE 6.08

RELATIONSHIP BETWEEN THE MATHEMATICS BACKGROUND OF THE TEACHERS AND THEIR JUDGMENT OF THE DIFFICULTY OF DEVELOPING A CURRICULUM IN THE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

NUMBER OF MATH. COURSES	DIFFICULTY OF DEVELOPING A MATH. OPTION CURRICULUM					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NONE	.0	27.3	72.7	.0	.0			
1 - 3 COURSE(S)	2.3	51.2	34.9	11.6	.0			
4 - 6 COURSES	.0	34.6	44.2	21.2	.0	18.7	12	.10
7 - 9 COURSES	10.0	30.0	52.5	7.5	.0			
MORE THAN 9	7.1	35.7	42.9	14.3	.0			

NOTE: 1* - VERY EASY TASK
2* - NO MORE DIFFICULT THAN PLANNING FOR OTHER SUBJECTS
3* - MORE DIFFICULT THAN OTHER SUBJECTS
4* - VERY DIFFICULT TASK
5* - BEYOND MY ABILITY

TABLE 6.09

RELATIONSHIP BETWEEN THE CURRICULUM AND INSTRUCTION COURSES (ED. CI.) BACKGROUND OF THE TEACHERS AND THEIR JUDGMENT OF THE DIFFICULTY OF DEVELOPING A CURRICULUM IN THE MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

NUMBER OF ED. CI. COURSES	DIFFICULTY OF DEVELOPING A MATH. OPTION CURRICULUM					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
NONE	.0	36.7	50.0	13.3	.0			
½ - 1 COURSE	4.3	36.2	46.4	13.0	.0			
1½ - 2 COURSES	2.6	43.6	38.5	15.4	.0	8.1	12	.78
2½ - 3 COURSES	13.3	26.7	46.7	13.3	.0			
MORE THAN 3	.0	42.9	57.1	.0	.0			

NOTE: 1* - VERY EASY TASK
2* - NO MORE DIFFICULT THAN PLANNING FOR OTHER SUBJECTS
3* - MORE DIFFICULT THAN OTHER SUBJECTS
4* - VERY DIFFICULT TASK
5* - BEYOND MY ABILITY

Null Hypothesis 6

> There is no significant relationship between the professional background and the amount of overlap of the mathematics option program content with the core mathematics program content.
> (See questions 5, 6 and 31 of MOTQ).

One of the original intents was to avoid substantial overlap of mathematics option content with core mathematics content. It was of considerable interest to examine whether or not teaching experience at the junior high school level and teaching experience in mathematics option were related to the amount of content overlap. TABLE 6.10 and TABLE 6.11 indicate that there is no significant relationship at the .05 level. The null hypothesis was therefore not rejected.

It is interesting to note that teaching experience in mathematics option did not make any difference on the amount of content overlap of core mathematics with mathematics option. The assumption that there should have been a relationship was believed to be reasonable. It was assumed that as the years of teaching experience in mathematics option increase, the amount of content overlap would be reduced. This is obviously not the case.

TABLE 6.10

RELATIONSHIP BETWEEN THE TEACHING EXPERIENCE OF TEACHERS AT THE JUNIOR HIGH SCHOOL LEVEL AND THE AMOUNT OF OVERLAP OF THE MATH. OPTION PROGRAM CONTENT WITH THE CORE MATHEMATICS PROGRAM CONTENT

(PERCENTAGE BY ROWS) N = 160

TEACHING EXPERIENCE AT JUNIOR HIGH SCHOOL LEVEL	AMOUNT OF CONTENT OVERLAP				CHI SQUARE	df	p
	1*	2*	3*	4*			
NO EXPERIENCE	10.0	10.0	50.0	30.0			
1 YEAR	28.6	28.6	42.0	.0			
2 YEARS	.0	13.3	60.0	26.7	19.9	12	.07
3 YEARS	7.7	15.4	46.2	30.8			
MORE THAN 3	5.2	7.0	36.5	51.3			

NOTE: 1* - VERY SUBSTANTIAL
2* - SUBSTANTIAL
3* - MODERATE
4* - AS LITTLE AS POSSIBLE

TABLE 6.11

RELATIONSHIP BETWEEN THE TEACHING EXPERIENCE OF TEACHERS IN MATHEMATICS OPTION AND THE AMOUNT OF OVERLAP OF THEIR MATHEMATICS OPTION PROGRAM CONTENT WITH THE CORE MATHEMATICS PROGRAM CONTENT

(PERCENTAGE BY ROWS) N = 160

TEACHING EXPERIENCE IN MATH. OPTION	AMOUNT OF CONTENT OVERLAP				CHI SQUARE	df	p
	1*	2*	3*	4*			
NO EXPERIENCE	10.0	6.7	56.7	26.7			
1 YEAR	.0	11.8	41.2	47.1			
2 YEARS	5.7	8.6	48.6	37.1	14.5	12	.27
3 YEARS	2.9	14.7	38.2	44.1			
MORE THAN 3	9.1	6.8	25.0	59.1			

NOTE: 1* - VERY SUBSTANTIAL
2* - SUBSTANTIAL
3* - MODERATE
4* - AS LITTLE AS POSSIBLE

Null Hypothesis 7

> There is no significant relationship between the academic background and the amount of overlap of the mathematics option program content with the core mathematics program content.
> (See questions 8, 10 and 31 of MOTQ).

The academic background of teachers included the number of mathematics courses and curriculum and instruction courses in mathematics. TABLE 6.12 and TABLE 6.13 show the relationships of both to the amount of content overlap of mathematics option with core mathematics. From the data it is evident that there is no significant relationship between the number of mathematics courses and content overlap. In fact a closer examination of TABLE 6.12 reveals that of those teachers with no mathematics courses none indicated a substantial or very substantial content overlap. The teachers with mathematics background, on the other hand, were found, at least to some extent, in the substantial or very substantial overlap categories.

TABLE 6.13 shows a significant relationship between the number of curriculum and instruction courses in mathematics and the amount of content overlap. In general, it appears that an increase in the number of curriculum and instruction courses will reduce the amount of content overlap.

Since both relationships had to be significant, therefore the null hypothesis was not rejected.

TABLE 6.12

RELATIONSHIP BETWEEN THE MATHEMATICS BACKGROUND OF TEACHERS AND THE AMOUNT OF OVERLAP OF THEIR MATHEMATICS OPTION PROGRAM CONTENT WITH THE CORE MATHEMATICS PROGRAM CONTENT

(PERCENTAGE BY ROWS) N = 160

NUMBER OF MATH. COURSES	AMOUNT OF CONTENT OVERLAP				CHI SQUARE	df	p
	1*	2*	3*	4*			
NONE	.0	.0	54.5	45.5			
1 - 3 COURSE(S)	18.6	9.3	32.6	39.5			
4 - 6 COURSES	1.9	15.4	38.5	44.2	20.5	12	.06
7 - 9 COURSES	2.5	5.0	45.0	47.5			
MORE THAN 9	.0	7.1	50.0	42.9			

NOTE: 1* - VERY SUBSTANTIAL
2* - SUBSTANTIAL
3* - MODERATE
4* - AS LITTLE AS POSSIBLE

TABLE 6.13

SIGNIFICANT RELATIONSHIP BETWEEN THE NUMBER OF CURRICULUM AND INSTRUCTION COURSES (ED. CI.) OF TEACHERS IN MATHEMATICS AND THE AMOUNT OF OVERLAP OF THEIR MATHEMATICS OPTION PROGRAM CONTENT WITH THE CORE MATHEMATICS PROGRAM CONTENT.

(PERCENTAGE BY ROWS) N = 160

NUMBER OF ED. CI. COURSES	AMOUNT OF CONTENT OVERLAP				CHI SQUARE	df	p
	1*	2*	3*	4*			
NONE	16.7	6.7	36.7	40.0			
½ - 1 COURSE	5.8	2.9	43.5	47.8			
1½ - 2 COURSES	2.6	15.4	38.5	43.6	26.3	12	.01
2½ - 3 COURSES	.0	33.3	46.7	20.0			
MORE THAN 3	.0	.0	28.6	71.4			

NOTE: 1* - VERY SUBSTANTIAL
2* - SUBSTANTIAL
3* - MODERATE
4* - AS LITTLE AS POSSIBLE

Null Hypothesis 8

> There is no significant relationship between the ability of teachers to develop a curriculum in mathematics option and the amount of structure that they wished imposed.
> (See questions 36 and 37 of MOTQ)

Teachers were asked to judge their ability to develop a mathematics option curriculum. They were also asked to indicate how much structure they wished to have imposed on the option. The relationship of the teachers' ability and the amount of structure that they wished imposed is the content of null hypothesis 8.

TABLE 6.14 shows that there is no relationship at the .05 level and therefore the null hypothesis was not rejected. It is, however, evident from the data that no matter how the teachers judged their abilities, the majority indicated mathematics option should remain unstructured, but teachers should receive more assistance in terms of suggestions and ideas.

TABLE 6.14

RELATIONSHIP BETWEEN THE TEACHERS' JUDGMENT OF THEIR ABILITY TO DEVELOP A MATHEMATICS OPTION CURRICULUM AND THE AMOUNT OF STRUCTURE THAT THEY WISH IMPOSED ON MATHEMATICS OPTION

(PERCENTAGE BY ROWS) N = 160

JUDGMENT OF ABILITY TO DEVELOP MATH. OPTION CURRICULUM	AMOUNT OF STRUCTURE TO BE IMPOSED					CHI SQUARE	df	p
	1*	2*	3*	4*	5*			
VERY EASY TASK	.0	16.7	66.7	16.7	.0			
NO MORE DIFFICULT THAN PLANNING FOR OTHER SUBJECTS	.0	8.3	65.0	20.0	6.7			
MORE DIFFICULT THAN OTHER SUBJECTS	1.4	13.7	65.8	9.6	9.6	13.8	12	.32
VERY DIFFICULT TASK	4.8	14.3	52.4	4.8	23.8			
BEYOND MY ABILITY	.0	.0	.0	.0	.0			

NOTE: 1* - COMPLETELY STRUCTURED BY DEPARTMENT OF EDUCATION
2* - ONE-HALF STRUCTURED, OTHER HALF DEVELOPED BY TEACHER
3* - UNSTRUCTURED, BUT MORE ASSISTANCE IN TERMS OF SUGGESTIONS AND IDEAS
4* - COMPLETELY UNSTRUCTURED, AS IT EXISTS NOW
5* - BECAUSE OF THE WAY IT IS OPERATING, DROP IT!

CHAPTER VII

EVALUATION BY SCHOOL

Introduction

Student testing and teacher interviews were an important aspect of this study. In all, eleven schools from nine different areas participated in this study (see APPENDIX A for a summary of participating schools and school systems). It was hoped that the close examination of some schools would provide additional information to that received from the teachers through the Mathematics Option Teacher Questionnaire.

In fact, the investigator visited all eleven schools and interviewed the mathematics option teachers at these schools. A great deal was learned from these teachers about themselves, their mathematics option program, its setting in school, and of course, the mathematics option students (see APPENDIX H for the Teacher Interview Instrument).

The mathematics option students and non-mathematics option students were randomly selected from each of the participating schools and matched in number and grade. At the beginning of February and at the end of May all students wrote an attitude test and a creativity test in mathematics. In addition, the mathematics option students filled out a questionnaire. The performance of the non-mathematics option on those two tests served as relative standards for comparison with mathematics option students.

This chapter will be divided into eleven sections and each section deals with one school. Information about each school is drawn from the teacher interview, attitude tests, creativity tests and the mathematics option student questionnaire.

SCHOOL ONE

1. General Comments: This is a 15 teacher school and houses junior high school students only. It is located in the north-east section of Edmonton. The students come primarily from families with lower socio-economic status.

2. Teacher: He has ten years of teaching experience with nine years at the junior high school level. His five years experience in mathematics option date back to the year of inception in 1969. With his 5 mathematics courses and 2 curriculum and instruction courses in mathematics he feels adequately prepared to teach the mathematics option. In fact, it was his personal choice to teach mathematics option. Other than being a bit short of ideas sometimes, he experiences no other difficulties.

3. Type of Program: The teacher considers his program primarily a general interest course. His grade 7 and 8 students are exposed to such topics as:

1. Mathematical Games
    a. Krypto
    b. Mind benders
    c. Vectors
    d. Equations
    e. Wff'n Proof
    f. On sets
    g. and others

2. Chess

3. Geometry
    a. Line designs
    b. Tangrams
    c. Pentominals
    d. Paper folding
    e. Creative construction
    f. Polyhedra

4. Probability and Statistics

The teacher indicated that he continually modifies these units and also develops new units for inclusion in the program.

Very little overlap of mathematics option content with core mathematics content was being observed. The students at this school strongly supported this observation.

4. Instructional Modes: Each new activity within each unit was briefly introduced by the teacher to the whole class. This was then followed up with worksheets or activities appropriate for the topics at hand. Students were allowed to work in small groups or on their own.

Student responses seem to confirm the teacher's description of his approach in mathematics option.

5. Time Allotment and Program Length: According to this teacher it was sufficient to offer 2 to 3 forty minute periods each week for a full year course. When asked what program length he preferred, he indicated that mathematics option should be offered as a full year course.

6. Materials and Facilities: It was the opinion of this teacher that potentially good activities had to be omitted from the option program because of the lack of basic materials. Furthermore, he regretted that his school did not have a video tape recorder thus preventing him from showing tapes dealing with chess and many other areas in his program.

7. Class Sizes: Four classes of grade 7 and 8 students were taught by this teacher. Only one class had between 21 and 25 students. Two classes had between 26 and 30 students while one class had over 30 students.

8. Objectives of Mathematics Option: Three objectives were of importance to this teacher in his program. These were: (1) to show that mathematics is enjoyable and informative, (2) to acquaint students with new areas of mathematics which are not part of the core program, and (3) to improve the students' attitude toward mathematics.

He also felt that this program is bound to have an effect on the students' mathematical fluency and their achievement in core mathematics.

From the responses of his students it appears that nearly two-thirds of the students understand the teacher's objectives and 80% indicated that they liked mathematics option.

9. Student Assignment to Option: Eight different options are being offered at this school and every attempt is being made to place students in the first four options of their choice. The student responses to the questionnaire revealed that 95% had chosen on their own to be in mathematics option. However, only 35% of the students chose it because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO) : Students from grade 7 and 8 were tested in School #1 at TIME 1 and TIME 2. The results are shown in TABLES 7.01 and 7.02. There were no significant differences at the .05 level between the MO students and NMO students in grade 7 on any of the nine concepts at TIME 1. Thus null hypothesis #9 was not rejected for any concept. At TIME 2 only the first concept (MATHEMATICS) produced significant differences between the two groups. Mathematics option students has a significantly higher mean score than NMO students toward the concept "MATHEMATICS". Thus the null hypothesis was rejected for concept #1 only.

TABLE 7.01

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #1)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	50.3	47.7	18	.69	.49	52.1	44.6	18	2.34	.03
2	48.4	47.1	18	.22	.83	48.1	54.3	18	-1.18	.25
3	56.2	50.1	18	1.42	.17	50.5	48.1	18	.54	.60
4	53.8	50.9	18	.78	.45	47.0	47.2	18	-.04	.97
5	55.7	56.8	18	-.29	.78	55.1	53.6	18	.49	.63
6	54.9	47.9	18	1.37	.19	47.3	46.2	18	.29	.78
7	51.7	54.5	18	-.68	.50	53.8	51.5	18	.52	.61
8	55.9	52.5	18	.78	.44	49.6	45.4	18	.92	.37
9	54.0	53.3	18	.13	.90	51.5	54.3	18	-.76	.46

* MEAN = 50, STANDARD DEVIATION = 10

THE NINE CONCEPTS ARE AS FOLLOWS: (1) Mathematics, (2) My Math Techer Is, (3) Myself, (4) Taking a Math Test Is, (5) My School, (6) My Math Class Is, (7) My Classmates Are, (8) My Math Textbook Is, and (9) Math Homework Is.

TABLE 7.02 shows the results of grade 8 students at school one. A significant difference in the mean score existed between MO students and NMO students for concept one at TIME 1. However, it was the NMO group which had a significantly better attitude toward mathematics. The difference in attitude at TIME 2 was again in favor of the NMO group but it was not significant. The third concept ("MYSELF") produced a significant difference in mean score in favor of the NMO group at TIME 2.

In general, no significant differences between the mean scores occurred for nearly all concepts. This suggests perhaps that the scales had some validity and that the MO group did not try to produce results that merely please.

TABLE 7.02

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #1)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	38.5	47.7	18	-2.08	.05	41.6	44.2	18	-.37	.71
2	50.1	42.7	18	1.17	.26	55.7	58.8	18	-.58	.57
3	45.9	48.3	18	-.53	.61	48.0	53.6	18	-2.16	.04
4	44.1	48.6	18	-.91	.38	57.0	54.6	18	.51	.61
5	51.3	51.1	18	.04	.97	48.8	46.8	18	.42	.68
6	49.9	44.4	18	.97	.35	54.7	56.3	18	-.27	.79
7	52.8	47.9	18	1.82	.09	52.5	46.2	18	1.19	.25
8	45.1	48.4	18	-.73	.48	46.9	47.2	18	-.07	.95
9	49.4	45.9	18	.76	.46	45.3	44.1	18	.24	.81

* MEAN = 50, STANDARD DEVIATION = 10

11. Creativity of Mathematics Option Students (MO) versus Non-Mathematics Option Students (NMO):

The results from the creativity test, which was administered at TIME 1 and TIME 2, are shown in TABLE 7.03. The mean score of the grade 7 MO group was slightly higher than that of the NMO group at TIME 1 and TIME 2. The differences, however, were not significant. This was exactly reversed for grade eight students. Here, NMO students showed slightly higher mean scores at both times, but again they were not significant. The null hypotheses were, therefore, not rejected.

Somewhat higher mean scores were noted for both grades at TIME 2. This is likely due to the learning effect of the test at TIME 1.

12. Teacher's Recommendations: The following recommendations were made by the teacher from school one.

a) Mathematics option should continue to be offered in its present structure and to all junior high school grades.

b) Department of Education should provide an outline of ideas and suggestions only. No compulsory texts.

c) Mathematics option should not be used for remedial purposes in core mathematics.

d) Teachers teaching the option should be provided with more time for planning and organization.

TABLE 7.03

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2
(SCHOOL #1)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
7	10.7	9.4	18	.57	.58	12.6	12.4	18	.09	.93
8	9.4	10.9	18	-.66	.52	12.6	14.4	18	-.53	.60

SCHOOL TWO

1. General Comments: This is a 21 teacher school, housing grades 7, 8, and 9. It is located in the eastern section of Edmonton. The student population ranges from 450-500 students with varying socio-economic backgrounds. The majority of the students come from homes with average socio-economic status. The remainder of the students are either from welfare families or from families with above average income.

2. Teacher: He has 31 years of teaching experience in total and at the junior high school level. He taught mathematics option for the last 5 years. With a total of 10 mathematics courses he feels adequately prepared to teach mathematics option. It was the teacher's personal choice to teach mathematics option.

3. Type of Program: This program was designed for grade 8 students and was considered an enrichment program. Few topics were dealt with during the year but they were treated thoroughly and in depth. The emphasis of the program was placed on geometry. Some major topics covered were:

1. Polyhedra
   a. theory
   b. construction
2. Line designs
3. String designs
4. Topology
5. Mathematical Games and Puzzles

From the student responses it is evident that the overlap of the mathematics option program with the core mathematics program is very minimal. Students have considerable input in developing activities for the option. The teacher provides additional ideas and in general guides the student suggestions within the framework of existing materials, resources, and facilities.

4. Instructional Modes: A new topic was introduced by the teacher to the whole class from which individual or group activities followed. Group sizes varied considerably depending on the interests and abilities of the students. Often the whole class did the same activity with each student working by himself. Resource people from the community were also used from time to time.

5. Time Allotment and Program Length: Three forty minute periods per week for a full year course were considered sufficient. A full year course was also the preferred program length of this teacher. The students, on the other hand, did not fully agree with the time allotment, because 60% indicated that they had not enough time per week for the mathematics option.

6. Materials and Facilities: No problems with materials and facilities were experienced at this school. In fact, this teacher was saying, "we have resources to teach almost anything". From the student response it appears that there is really not an overabundance of materials and facilities. Only 40% felt that they had enough, 40% were unsure, and 20% indicated a lack of materials and facilities.

7. Class Sizes: Two grade 8 classes of mathematics option were taught by this teacher. One class had between 21 and 25 students and the other had between 26 and 30 students.

8. Objectives of Mathematics Option: This program had two objectives in mind. These were: (1) to improve and maintain good attitudes toward mathematics and school and (2) to develop creative thinking in mathematics.

When the students were asked how clear the teacher's objectives were to them, 80% indicated that they understood the objectives.

9. Student Assignment to Option: An option form, containing all options offered at the school, is handed to each student and he is to pick his first 6 choices. Every effort is being made to assign each student to his first 4 choices. The student responses to the questionnaire revealed that 80% of the mathematics option students had chosen to be in the mathematics option. Only 20% of the students chose it because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The results of these tests at TIME 1 and TIME 2 are shown in TABLE 7.04. For all nine concepts there were no significant differences at the .05 level between MO students and NMO students at TIME 1. Thus the null hypothesis was not rejected for any of the concepts. Likewise at TIME 2, no significant differences occurred between the two groups for all nine concepts.

It has been the objective of this teacher's program to improve and maintain good attitudes twoard mathematics. From TABLE 7.04 it can be seen that a slight improvement of attitudes occured from TIME 1 to TIME 2 except for concept three. The least that can be said is that the students have maintained their attitudes from TIME 1 to TIME 2.

TABLE 7.04

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #2)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	P (two-tailed)	MO	NMO	df	t	P (two-tailed)
1	54.1	51.0	18	.58	.57	56.7	49.6	18	1.49	.15
2	42.4	42.5	18	-.04	.97	53.8	58.6	18	-.90	.38
3	47.4	41.8	18	1.23	.23	46.9	45.3	18	.29	.77
4	45.7	44.1	18	.33	.74	53.7	56.0	18	-.62	.54
5	48.8	53.0	18	-1.10	.29	51.5	49.5	18	.35	.73
6	43.6	46.1	18	-.55	.59	53.3	57.7	18	-.91	.38
7	54.2	54.2	18	.005	1.00	55.8	49.4	18	1.68	.11
8	46.9	43.0	18	.97	.34	51.4	50.4	18	.19	.85
9	47.3	48.6	18	-.37	.72	52.4	50.1	18	.43	.67

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.05

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #2)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two tailed)	MO	NMO	df	t	p (two-tailed)
8	12.9	9.1	18	1.55	.14	14.7	9.1	18	2.55	.02

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.05 shows the results of the creativity test which was administered at TIME 1 and TIME 2. Although the mean score of the MO students is higher than that of the NMO students, the difference, however, was not statistically significant. Therefore the hypothesis was not rejected at the .05 level. At TIME 2 the MO students had a significantly higher mean score. The null hypothesis was, therefore, rejected.

The data seem to indicate that the objective to develop creative thinking in mathematics has been achieved by this teacher. While the NMO students did not improve their score from TIME 1 to TIME 2, the MO students did show growth in creative thinking.

12. Teacher's Recommendations: The following points were made:

a) That the teacher should be the sole person to determine the amount of structure in mathematics option.

b) That no structure be imposed by the Department of Education.

c) That mathematics option be offered already at the upper elementary level.

d) That if mathematics option is used for remedial purposes in core mathematics, then no other students should be assigned to the same class.

SCHOOL THREE

1. General Comments: This school houses grades 1 to 9 and has 24 teachers. The 490 students come primarily from middle class families and some from families with lower socio-economic status. The school is located in the south-east section of Edmonton and is surrounded by old but well-established residences.

2. Teacher: With nine mathematics courses and two curriculum and instruction courses in mathematics he felt adequately prepared to teach mathematics option. All of his 12 years teaching experience were spent at the junior high school level. He taught mathematics option for five years and indicated that he enjoys teaching it despite the fact that he was assigned by the principal.

3. Type of Program: The program was described as a general interest course with the following topics being covered:

   1. Polyhedra
   2. Logic
   3. Trigonometry
   4. Slide Rule
   5. Calculator
   6. Exponents
   7. Conditions
   8. Mathematical Games and Puzzles
   9. Tangrams
   10. Curve stitching

   All topics are prescribed to the students by the teacher. A certain amount of freedom is allowed within each topic. Students are permitted to choose the parts of interest to them in any given topic.

According to the students there appears to be substantial overlap of mathematics option content with core mathematics content. The inclusion of core mathematics content in mathematics option occurred "all of the time" according to 5% of the students. Thirty percent claimed that it happened "much of the time".

4. Instructional Modes: Each activity is preceded by an introduction from the teacher. Students then work almost always by themselves or in small groups. The responses to the student questionnaire strongly support this observation.

5. Time Allotment and Program Length: Approximately four forty minute periods per week were considered sufficient for a whole year course. The majority of his students were in agreement with this statement. However, as far as the program length was concerned he much rather preferred mathematics option to be semestered.

6. Materials and Facilities: It was pointed out that his program has a serious shortage of supplies. He indicated that this shortage was due to insufficient funds.

7. Class Size: The two mathematics option classes had enrolments between 26 and 30 students.

8. Objectives of Mathematics Option: The teacher had two objectives in his course. None was expressed in terms of expected student behavior. These were: (1) to expose students to mathematics topics of interest to them, and (2) to provide an atmosphere in the classroom that permits students to study and explore mathematics in a relaxed manner.

9. Student Assignment to Option: Two options are assigned to students and two options are chosen by students from approximately 10 choices. Only 55% of the students were in mathematics option by personal choice and 45% chose it because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

Grades 8 and 9 were tested at this school. The results are shown in TABLES 7.06 and 7.07. The data in TABLE 7.06 show that no significant differences in mean scores existed for all nine concepts at TIME 1 for the two groups. Therefore, the null hypothesis was not rejected. Likewise at TIME 2, none of the scores showed a significant difference. It is interesting to note that at TIME 2 the mean score of the MO students is, with oneexception, lower than that of the NMO students.

TABLE 7.07 shows the results for grade 9. The mean scores of the MO students and NMO students were not significantly different for any concept at TIME 1. At TIME 2, a significant difference was found in their attitude toward mathematics. While the MO students showed no changes between TIME 1 and TIME 2, the NMO students had a considerable drop in mean score from TIME 1 to TIME 2. The mean scores for all other concepts showed no significant differences.

TABLE 7.06

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #3)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	52.3	54.1	18	-.48	.64	52.8	53.2	18	-.11	.92
2	40.5	37.7	18	.68	.51	61.7	62.6	18	-.17	.87
3	51.2	52.4	18	-.34	.74	52.4	50.2	18	.52	.61
4	48.0	48.5	18	-.20	.85	52.5	55.5	18	-.88	.39
5	50.4	50.1	18	.10	.92	50.1	51.5	18	-.38	.71
6	49.4	45.1	18	1.40	.18	56.2	57.4	18	-.30	.77
7	52.6	46.7	18	1.42	.17	47.4	50.8	18	-.94	.36
8	47.7	46.4	18	.35	.73	51.0	54.5	18	-.75	.47
9	46.6	45.0	18	.42	.68	44.7	48.7	18	-.78	.45

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.07

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #3)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	P (two-tailed)	MO	NMO	df	t	P (two-tailed)
1	53.7	52.5	18	.23	.82	53.6	46.3	18	2.05	.05
2	57.4	52.5	18	1.56	.14	45.6	49.1	18	-1.14	.27
3	59.3	53.1	18	1.83	.08	53.0	51.7	18	.37	.71
4	44.0	49.6	18	-1.05	.31	53.6	49.9	18	.93	.37
5	49.4	46.0	18	.63	.54	49.2	45.9	18	.23	.82
6	51.9	52.7	18	-.26	.80	47.2	49.7	18	-.81	.43
7	46.9	45.1	18	.37	.72	47.6	42.7	18	.93	.36
8	44.4	48.9	18	-1.22	.24	51.3	46.5	18	1.75	.10
9	47.4	51.6	18	-1.14	.27	51.1	48.0	18	.83	.42

* MEAN = 50, STANDARD DEVIATION = 10

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.08 shows the results of the test for grade 8 and 9 at TIME 1 and TIME 2. Although the grade 8 mean scores for MO students were slightly higher than for NMO students at both times, the differences, however, were not significant.

For grade 9 the situation was the exact reverse. At TIME 1 and TIME 2, NMO students received higher mean scores. The differences were not significant and the null hypothesis was therefore not rejected.

12. Teacher's Recommendations: Three recommendations were made by this teacher.

a) Mathematics option should continue to be offered in its present structure.

b) The Department of Education should not impose any structure on mathematics option.

c) Students in mathematics option should have a choice as to what topics they wish to study.

TABLE 7.08

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #3)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
8	13.7	12.0	18	.83	.42	13.8	12.6	18	.48	.64
9	15.7	18.2	18	-.97	.35	15.8	17.7	18	-.80	.44

SCHOOL FOUR

1. General Comments: This school is located east of Edmonton in the farming community of Vegreville. Grades 7 to 9 are being taught at this school with a staff of fourteen teachers. The students come primarily from the community itself and from the surrounding area.

2. Teacher: All of his 10 years teaching experience were spent at the junior high school level. He has taught mathematics option for three years now and has done so by personal choice. With his 7 courses in mathematics and 2 courses in curriculum and instruction in mathematics, he feels better than average prepared to teach mathematics option.

3. Type of Program: This program is strongly business education oriented. With the exception of few units, the emphasis is placed on business education. The topics are as follows:

1. Metric System
2. Merchandizing
    a. Gains
    b. Losses
3. Banking
    a. Rates
    b. Interest
    c. Principal
    d. Percentages
    e. Ratios
    f. Related skills (eg. decimals, division, fractions, etc.)

Only 20% of his students felt that the content of his mathematics option program overlaps considerably with the core mathematics program.

Students also play an active part in structuring the program. They suggest many topics and present ideas and the teacher then builds activities around these ideas.

4. Instructional Modes: In most instances the teacher interacts with the whole class. This takes on various forms - class discussions, showing a video tape, film or filmstrips and lectures. Often the projects are such that small groups are being used.

From the student responses it can be seen that 60% work by themselves and 30% work in small groups. In most cases the whole class was involved in the same activity with each student working by himself.

5. Time Allotment and Program Length: Three forty minute periods per week were considered sufficient for a whole year program. In fact, this teacher felt that mathematics option should be offered as a full year program. Only 20% of his students indicated that they did not have enough time per week in the mathematics option.

6. Materials and Facilities: The only major problem that existed was a lack of reference materials for the course. Students did not quite see it this way because 90% of them claimed that they always had enough materials and facilities for projects in mathematics option. Of course, the teacher's and students' opinions on what is sufficient for the course is not necessarily congruent.

7. Class Sizes: More than 30 students were enrolled in his mathematics option class. This, no doubt, has considerable influence on the type of program and the instructional modes being used.

8. Objectives of Mathematics Option: Four objectives were to be attained by this teacher. They are as follows: (1) to increase the ability of students to transfer knowledge, (2) to think critically, (3) to improve the ability in logical thinking and finally (4) to allow students

to study topics of their choice.

It was also indicated by 90% of the students that these objectives were clear to them.

9. Student Assignment to Option: The school offers 5 to 7 options from which students choose four. The teacher had no input in selecting students for the option. While all students agreed that taking mathematics option was their own choice, only 30% chose it because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The test results for grade 8 are shown in TABLE 7.09. The data at TIME 1 reveal no significant differences between the mean scores of the MO group and NMO group for all concepts. However, except for concept #7 (My Classmates Are), the MO students had a slightly more favorable attitude toward the concepts than the NMO students.

At TIME 2, significant differences between the means occurred for two concepts. The attitude toward mathematics and mathematics homework was significantly better for the MO students. The null hypothesis was not rejected for all other concepts.

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students(NMO)

TABLE 7.10 shows that the MO students had a slightly lower mean than the NMO students on both occasions. The difference of the means, however, was not significant. Both groups did show some growth from TIME 1 to TIME 2.

TABLE 7.09

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #4)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	48.5	45.7	18	.85	.41	53.4	45.0	18	2.36	.03
2	51.3	47.6	18	1.14	.27	50.3	51.7	18	-.54	.60
3	53.2	50.0	18	.97	.34	55.8	53.0	18	.52	.61
4	55.5	48.5	18	2.00	.06	50.2	47.4	18	.65	.52
5	56.1	52.8	18	1.38	.18	54.1	51.3	18	1.06	.30
6	52.7	51.3	18	.55	.59	44.5	48.8	18	-2.00	.06
7	53.8	59.3	18	-1.86	.08	51.4	50.0	18	.43	.68
8	55.6	52.6	18	1.06	.30	51.6	45.2	18	1.27	.22
9	55.2	52.2	18	.87	.40	54.1	46.7	18	2.05	.05

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.10

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #4)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
8	11.0	11.5	18	-.19	.85	13.8	14.3	18	-.16	.88

12. Teacher's Recommendations: The following recommendations were made by this teacher:

   a. Mathematics option should remain unstructured.

   b. The Department of Education should provide a book of ideas and suggestions.

   c. There should be more financial assistance for the acquisition of resources, materials and supplies.

   d. Mathematics option should be taught in grades eight, nine, and high school.

   e. Schools should insist on homogeneous groupings in terms of mathematical ability.

SCHOOL FIVE

1. General Comments: This is a junior high school with 40 teachers and is located in the city of Grande Prairie. Nearly all of the students come from the community.

2. Teachers: Two teachers were interviewed at this school. Grade nine students were taught by a teacher with 9 years of total teaching experience and one year in mathematics option. He considers himself adequately prepared with 9 mathematics courses and one course in curriculum and instruction in mathematics. Although the teaching of mathematics option was not his personal choice, he indicated, however, that he did not object too much.

The other teacher taught mathematics option to grades seven and eight. She was assigned by the principal and had no personal choice in whether or not to teach mathematics option. She taught for a total of 6 years of which she spent 1 year at the junior high school level and in mathematics option. With four courses in mathematics and one course in curriculum and instruction in mathematics she felt adequately prepared to teach the option.

3. Type of Program: The program being offered to grade nine students was described to be an enrichment program. Some of the topics were or will be part of the core mathematics program. Students had the opportunity to study some of these topics in more depth. Here are some of the topics which are part of the program.

1. Computer
2. Trigonometry
3. Probability and Statistics

4. Permutations and Combinations
5. Polyhedra (Theory and Construction)
6. Bases - Logarithm
7. Mathematical Games and Puzzles

The program offered by the other teacher to grades seven and eight is also an enrichment program and includes topics such as:

1. Slide Rule
2. Creative Construction and Line Designs
3. Mathematical Games and Puzzles
4. Topology
5. Bases
6. Probability and Statistics
7. Problem Solving
8. Unit on Algebra

Both teachers allowed some input from students in the program. Students suggested topics and ideas but the teachers then made the selection from this pool of ideas.

While the majority of the students described the overlap of mathematics option content with core mathematics content as minimal, over one-third indicated that there was a substantial overlap of content.

4. Instructional Modes: Only minor differences in approach were observed between the two teachers. The grade nine teacher preferred to introduce each topic which was then followed up by group discussions, activities and study. Individual projects were rarely pursuit, however, they were permissible.

The other teacher laid emphasis on group and individual activities. Teacher lectures were also used from time to time.

Student responses seem to confirm the statements above. While more than one-half indicated that they mostly work in small groups, 36% said that they worked primarily by themselves.

5. Time Allotment and Program Length: Both teachers felt that three forty minute periods per week would be sufficient for a full year course. Seventy percent of the students agreed with this.

Different opinions were expressed with regard to program length. The teacher in grade nine much rather preferred a semestered course, while the other teacher would like to see mathematics option offered as a full year course only.

6. Materials and Facilities: Again, the two teachers differed in their opinions. No problems were experienced by the teacher teaching grade nine. The other teacher pointed at a lack of materials and references for mathematics option.

Also, the student responses seem to suggest all is not well in this area. Only about 50% indicated that there were enough materials and facilities for projects in mathematics option. The remainder of the students was not so sure or else indicated that there was a lack of materials and facilities.

7. Class Sizes: One teacher's class was between 26 and 30 students and the other teacher's classes were both over 30 students.

8. Objectives of Mathematics Option: It was the objective of the grade nine teacher to study in-depth those topics in which students have shown an interest.

The objectives of the other teacher were as follows: (1) expose students to different areas of mathematics, and (2) to provide a challenge for the mathematically capable students.

From the responses it is evident that students do understand what their teacher is trying to do in mathematics option. Only 13% of the students expressed doubt over the teacher's aims and objectives.

9. Student Assignment to Option: Students may choose two out of the four options. It was suggested by the teachers that only about one-half of the students select mathematics option by free choice. This is not so at all because over 90% of the students indicated that taking mathematics option was their own free choice. More than 70% chose mathematics option out of interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.11 shows the test results for grade seven. The data reveal no significant differences between the mean scores of the MO group and NMO group for all concepts at TIME 1 and TIME 2. Thus the null hypothesis was not rejected for any concept.

TABLE 7.12 contains the test results for grade eight. A significant difference in attitude toward mathematics is shown at TIME 1. However, it is the NMO group which has a significantly better attitude toward mathematics than the MO group. At TIME 2 both mean scores for concept one had fallen below the mean of 50. They are, however, no longer significantly different. Still, the NMO students had a more favorable attitude toward mathematics than the MO students. No significant differences in mean score occurred between the two groups for all other concepts.

TABLE 7.11

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #5)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	52.1	47.5	18	.88	.39	51.1	47.1	18	.67	.51
2	51.3	49.3	18	.69	.50	57.0	56.2	18	.15	.88
3	52.8	51.2	18	.44	.67	47.4	45.4	18	.70	.49
4	45.5	45.5	18	-.01	.99	52.9	56.0	18	-.71	.49
5	49.4	51.6	18	-.57	.58	49.5	44.1	18	1.09	.29
6	48.5	40.9	18	1.33	.20	58.6	63.6	18	-.87	.39
7	52.0	50.3	18	.44	.66	47.1	46.7	18	.06	.95
8	45.3	41.8	18	.70	.50	51.2	44.7	18	1.48	.16
9	45.7	45.7	18	.01	1.00	47.4	42.6	18	1.18	.25

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.12

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #5)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	45.3	53.6	18	-2.12	.05	46.2	49.0	18	-.85	.41
2	45.0	51.7	18	-1.44	.17	50.2	46.2	18	1.01	.32
3	50.0	47.2	18	.68	.50	48.8	52.7	18	-.88	.39
4	57.3	54.1	18	1.32	.20	44.0	45.0	18	-.33	.75
5	52.9	51.1	18	.53	.60	47.5	52.8	18	-1.13	.27
6	49.8	48.2	18	.46	.65	51.7	48.3	18	.95	.36
7	47.2	47.1	18	.02	.99	47.9	48.6	18	-.18	.86
8	53.2	51.9	18	.42	.68	44.4	50.8	18	-2.01	.06
9	53.9	52.6	18	.33	.75	49.7	53.3	18	-.90	.38

*MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.13

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #5)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	48.0	45.6	18	.65	.53	48.7	42.3	18	2.38	.03
2	50.8	51.4	18	-.29	.77	45.8	48.2	18	-.75	.46
3	54.9	48.2	18	1.73	.10	48.0	48.8	18	-.28	.78
4	53.0	52.7	18	.07	.94	48.6	48.5	18	.02	.99
5	55.0	48.8	18	2.39	.03	49.8	48.1	18	.43	.67
6	51.1	51.2	18	-.04	.97	46.2	49.1	18	-.88	.39
7	50.3	49.5	18	.23	.82	52.4	49.8	18	.87	.39
8	52.1	51.0	18	.25	.80	50.1	49.2	18	.26	.80
9	51.0	51.1	18	-.02	.99	51.7	49.4	18	.62	.55

* MEAN = 50, STANDARD DEVIATION = 10

The grade nine test results may be found in TABLE 7.13. Except for concept #5 ("My School"), all other concepts show no significant differences in mean score at TIME 1. Mathematics option students do have a better attitude toward their school. At TIME 2, concept #1 ("Mathematics") shows a significant difference in mean score in favor of the MO group. It should be noted, however, that the scores of both groups lie below the mean of 50 for concept #1. The remaining concepts at TIME 2 show no significant differences in mean score. The null hypothesis was, therefore, not rejected.

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.14 shows the results of the creativity test for all three grades. While the MO group shows a higher mean score for all three grades at TIME 1, only the grade 9 MO group performed significantly better than the NMO group in grade 9.

At TIME 2 the data indicate significant differences in grade mean for grades seven and nine. In both instances theMO groups produced higher mean performances. This was not so for grade eight students. Here the NMO students have a slightly higher mean than the MO students. The null hypothesis was not rejected for the performance of grade seven and eight students at TIME 1 and for grade eight students at TIME 2.

TABLE 7.14

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #5)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	P (two-tailed)	MO	NMO	df	t	P (two-tailed)
7	8.3	5.4	18	1.78	.09	9.8	5.5	18	2.49	.02
8	9.3	7.0	18	1.33	.20	12.1	14.1	18	-.58	.57
9	18.5	11.8	18	2.67	.02	17.6	11.0	18	2.90	.01

12. Teacher's Recommendations: The recommendations of both teachers are combined and presented here. They are as follows:

a. Greater cooperation and collaboration between the schools within the system and between the systems should be fostered.

b. The Department of Education should establish a bank of ideas for mathematics option.

c. Restrictions should be placed on class sizes for mathematics option.

d. Mathematics option should not be used for remedial purposes in core mathematics but rather for strong and capable students in mathematics.

e. Mathematics option should be offered not just in junior high school but also in high school.

SCHOOL SIX

1. General Comments: This school is located 40 miles south of Edmonton near Millet. Eight teachers are on staff with grades from one to eight. The students are bussed in from the surrounding farms and from a nearby oil scrubbing plant.

2. Teacher: He has spent eight of his ten years teaching experience at the junior high school level. It was his personal choice to teach mathematics option for the second year in a row now. The mathematical background of this teacher include five mathematics courses and one curriculum and instruction course in mathematics. He indicated that he feels inadequately prepared to teach mathematics option because of the lack of curriculum and instruction courses in mathematics.

3. Type of Program: It was described as a general interest course with a strong base in business education. The main topics are as follows:

   1. Business mathematics
   2. Consumer education
   3. Probability
   4. Geometry

Students do help to structure the course by suggesting many activities. In general, students are given a choice of topics. Every effort is made to have as little content overlap with core mathematics as possible. Only about 30% of the students claim that there is a substantial overlap of mathematics option content with core mathematics content.

4. Instructional Modes: The class is divided into groups of 3 to 4 students. Nearly one-half of the activities are done by these groups with the teacher attempting to assist each group.

The students see the situation somewhat different. 50% responded that they worked by themselves and over 30% indicated that they worked primarily in small groups.

Outdoor lab activities were used on many occasions according to the teacher.

5. Time Allotment and Program Length: Four forty-minute periods per week were considered sufficient for a full year course. He also indicated that he preferred a full year program over any other type of scheduling.

Nearly two-thirds of his students appear to be satisfied with the present allotment of time for mathematics option. Some 5% were undecided and just under 30% felt that the amount of time presently used was insufficient.

6. Materials and Facilities: The availability of resource materials was considered the major problem. Students saw it as a problem too. Only one-third of the students felt that they always had enough materials and facilities for projects in mathematics option.

7. Class Sizes: Both classes had between 26 and 30 students.

8. Objectives of Mathematics Option: This teacher had two objectives in mind with his program. They were (1) to demonstrate the usefulness of mathematics in daily life, and (2) to improve the attitude of students.

9. Student Assignment to Option: Students were given a choice between Mathematics option and Fine Arts. All students chose mathematics option and they all indicated that it was their own free choice. This might have been so but one must not forget that students only had a choice of two options. But, nevertheless, 61% of the students chose mathematics option out of interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.15 shows the test results for grade seven. The data reveal significant differences in mean scores for two concepts - Concept #1 ("Mathematics") and Concept #5 ("My School"). The difference of mean score of the MO group and NMO group for concept #1 is highly significant with the NMO group having a more favorable attitude toward mathematics. This is exactly the opposite for Concept #5. It is interesting to note, however, that both mean scores are below 50. The null hypothesis was rejected for concept #1 and #5. No significant differences existed for all the the other concepts at TIME 1.

At TIME 2 only one concept had significantly different mean scores. This was concept #7 ("My Classmates are"). Again, the attitude toward classmates was significantly better for the NMO group than for the MO group. The null hypothesis was not rejected for all other concepts at TIME 2.

TABLE 7.16 presents the test results for grade eight. The mean scores for the MO group and NMO group were not significantly different for any concept at TIME 1 and TIME 2. Therefore, the null hypothesis was not rejected for any concept.

TABLE 7.15

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #6)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	P (two-tailed)	MO	NMO	df	t	P (two-tailed)
1	43.4	57.3	18	-3.91	.001	52.2	55.8	14	-.83	.42
2	56.1	52.4	18	1.15	.27	44.0	47.7	14	-.83	.42
3	50.2	48.1	18	.35	.73	49.6	46.4	14	.78	.45
4	56.1	48.1	18	1.79	.09	49.0	54.0	14	-.68	.51
5	48.9	34.7	18	2.65	.02	47.7	42.8	14	.77	.45
6	53.5	45.4	18	1.75	.10	51.4	51.6	14	-.02	.98
7	51.2	49.5	18	.51	.62	43.9	55.1	14	-2.22	.04
8	55.4	48.3	18	1.44	.17	45.9	55.7	14	-1.58	.14
9	53.7	49.6	18	.81	.43	49.7	46.8	14	.46	.65

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.16

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #6)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	47.2	43.0	16	.59	.56	48.0	55.3	16	-1.32	.20
2	52.4	48.0	16	1.11	.28	44.6	46.4	16	-.53	.60
3	41.0	37.4	16	.73	.48	39.8	46.7	16	-1.32	.21
4	46.0	40.2	16	1.15	.27	51.5	59.9	16	-1.71	.11
5	38.9	32.8	16	1.23	.24	46.6	42.0	16	.86	.40
6	49.6	42.6	16	1.43	.17	48.1	54.5	16	-1.38	.19
7	44.3	46.0	16	-.26	.80	47.8	37.4	16	1.55	.14
8	47.2	39.4	16	1.40	.18	50.5	57.6	16	-1.09	.29
9	44.1	38.7	16	1.09	.29	45.7	40.7	16	.99	.34

* MEAN = 50, STANDARD DEVIATION = 10

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The test results are shown in TABLE 7.17 for both grades at TIME 1 and TIME 2. At TIME 1 only the mean scores of grade 8 are significantly different and in favor of the MO group. The grade 7 MO group produced a lower mean score than the NMO group at TIME 1.

The performance of the grade 7 MO group changed drastically at TIME 2. The MO group shows considerable improvement compared to TIME 1 while the grade 7 NMO group shows a considerable drop in performance. This resulted in a significant difference in mean score for grade 7 and the rejection of the null hypothesis.

The performance of the grade 8 MO students remained almost unchanged, while the NMO group showed a slight improvement. This narrowed the gap in the mean scores of these two groups. The null hypothesis was not rejected for grade 8 at TIME 2.

12. Teacher's Recommendations: The following recommendations were made:

a. Class sizes should not exceed 20 students for mathematics option.

b. Increased preparation time should be made available to teachers teaching mathematics option.

c. The Department of Education should not impose any structure on mathematics option.

d. The Department of Education should provide more ideas and suggestions to teachers teaching mathematics option.

TABLE 7.17

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #6)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
7	6.3	7.1	14	-.53	.60	9.6	4.5	14	3.03	.01
8	12.4	6.9	16	3.94	.001	12.1	8.8	16	1.73	.10

SCHOOL SEVEN

1. General Comments: This school is located in the community of Hythe. It has a staff of fourteen teachers and accommodates grades 7 to 9. The students come from the communities of Hythe and Beaverlodge but the majority come from the surrounding farms. The socio-economic status of the parents is considered average and above average.

2. Teachers: Three teachers were interviewed at this school. The first teacher taught a mathematics option course which was remedial in nature. This was by personal choice. With her two mathematics courses and two curriculum and instruction courses in mathematics she felt her background was sufficient to teach this remedial course to grade seven students. She has a total of nine years teaching experience with one year at the junior high school level. During that one year she also taught mathematics option.

The second teacher who was interviewed entitled her mathematics option course as "Business Mathematics and Everyday Uses". Her teaching assignment and choice of course were both the result of personal choice. She taught all of her nine years of teaching experience at the junior high school level and the last four years in mathematics option. With her six mathematics courses and one curriculum and instruction course in mathematics she considers herself adequately prepared to teach the mathematics option.

The third teacher taught an enrichment course and has done so for the last two years. He has been teaching for six years out of eight at the junior high school level. His academic background includes seven mathematics courses and three curriculum and instruction courses in mathematics. He considers himself adequately prepared to teach mathematics option.

3. Type of Program: Three distinct types of programs were offered at this school.

1. Remedial Program
    a) Whole numbers
    b) Fractions
    c) Percentage
    d) Problem solving
    e) Geometry
    f) Graphing
    g) Mathematics games
2. Business Mathematics and Everyday Uses
    a) Basic skills (remedial)
    b) Investments
    c) Banking
    d) Insurance
    e) Taxation
    f) Drafting
    g) Surveying
3. Enrichment
    a) Tangrams
    b) Trigonometry
    c) Logarithm
    d) Polyhedra
    e) Geometric construction
    f) Mathematics games and puzzles

From the student responses it appears that the majority of the students do have the freedom to choose mathematics option. It is, however, interesting to note that only 33% of the mathematics option students have chosen it because of their interest in mathematics.

In none of the three courses are the students allowed to work in any area of interest to them. In fact all three teachers do rigidly prescribe the content of their course to the students. This does not seem to be a serious drawback because 80% of the students indicated that mathematics option should continue to be offered the way it is. Also, 80% of the students remarked that they liked their mathematics option class.

4. Instructional Modes: In the remedial class the teacher prescribes the activities to students with common problems. This, invariably, results in small groups of students or students working by themselves. The teacher then tries to interact with each group as long and as frequently as she can. In many instances the students seek the assistance of other students. These activities are pursuit until the problem areas are mastered. It is only then that the students are allowed to choose an activity of interest.

In the business mathematics class the approach is a slightly different one. The teacher prepares a pool of activities of varying lengths and difficulty level. The students then have a choice to select an activity from those prepared in advance by the teacher. Nearly always are the activities handled by individual students or by small groups of students.

The enrichment course is handled in a similar manner. The teacher prepares lab activities in various areas and the students may then choose from these activities. Individual or small group work is allowed. Each activity demands a report which is prepared by the individual or small groups. The student responses seem to confirm the teachers' perception of the instructional modes.

5. Time Allotment and Program Length: Two to four forty minute periods per week were considered sufficient for a full year course. While the remedial and business mathematics teachers preferred the course to be semestered, the enrichment course teacher expressed indifference and

stated that the type of scheduling would have no bearing on the all-around success of this course.

The mathematics option students were asked if they had enough time per week and 90% indicated that they had sufficient time for mathematics option.

6. Materials and Facilities: There appears to be a lack of resources for the remedial course. It was also remarked that a general upgrading of all areas was needed. One teacher pointed out that a definite place should be assigned exclusively for mathematics option.

Students were also asked about the sufficiency of materials and facilities. Only 50% indicated that they had enough for projects in mathematics option.

7. Class Size: One of the remedial classes had less than 15 students and the other had between 21 and 25 students. The business mathematics class had between 21 and 25 students and the enrichment class had less than 15 students.

8. Objectives of Mathematics Option: The objectives are listed according to the type of course.

Remedial course: a) to improve computational skills
b) to improve their attitude towards mathematics

Business Mathematics and Everyday Uses:
a) to develop the student's confidence in mathematics through the development of basic skills
b) to demonstrate the need for and usefulness of mathematics in everyday life
c) to kindle the student's interest for further study

Enrichment Course:
a) to introduce students to different areas of mathematics.

The data seem to suggest that the students do understand the aims and objectives of their course. Nearly 87% of the students indicated that the objectives of their course seem clear to them.

9. Student Assignment to Option: The teachers indicated that in general students have a free choice of options. In some cases it was found to be in the best interest of the student to have him/her counselled into one of the three types of mathematics option courses. Nearly 77% of the students felt that they had a free choice in selecting mathematics option. Only 33% chose mathematics option out of interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.18 shows the test results for grade seven. No significant differences in mean score were found between the MO group and NMO group on all nine concepts at TIME 1 and TIME 2. Thus the null hypothesis was not rejected for grade seven students at TIME 1 and TIME 2.

The data for grade eight are shown in TABLE 7.19. Again, there were no significant differences in mean score between the MO and NMO group on all nine concepts at TIME 1 and TIME 2. The null hypothesis was therefore not rejected for grade eight students at TIME 1 and 2.

TABLE 7.20 shows the results for grade nine students. The data reveal a significant difference in mean score for concept #4 ("Taking a Math Test is") at TIME 1 and TIME 2. While the NMO group has a significantly better attitude toward concept #4 at TIME 1, the MO group has a significantly better attitude toward the same concept at TIME 2. The responses to this particular concept might suggest that students were trying to produce results that merely please.

TABLE 7.18

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #7)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	52.2	47.4	18	1.24	.23	51.6	50.7	18	.22	.83
2	52.6	56.4	18	-1.16	.26	47.3	46.7	18	.14	.89
3	50.1	47.6	18	.63	.54	55.9	46.4	18	1.93	.07
4	55.9	54.6	18	.36	.73	40.9	44.2	18	-.94	.36
5	58.2	59.2	18	-.49	.63	56.0	55.3	18	.25	.81
6	56.8	56.4	18	.17	.86	43.8	43.3	18	.18	.86
7	49.5	51.3	18	-.37	.71	51.5	53.7	18	-.66	.52
8	55.7	55.2	18	.15	.88	51.7	51.9	18	-.04	.97
9	58.5	55.1	18	1.24	.23	57.2	52.1	18	1.58	.13

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.19

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #7)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	55.0	53.7	18	.21	.83	50.7	54.8	18	-.68	.50
2	43.2	40.3	18	.49	.63	56.7	59.5	18	-.47	.65
3	49.4	44.1	18	1.03	.31	54.6	51.6	18	.81	.43
4	41.6	46.5	18	-.88	.39	57.5	54.0	18	.63	.54
5	45.9	53.8	18	-1.60	.13	45.3	54.5	18	-2.04	.06
6	37.7	39.9	18	-.37	.72	60.4	58.0	18	.38	.71
7	44.4	48.6	18	-.99	.33	47.7	53.8	18	-1.29	.21
8	46.3	47.4	18	-.20	.85	58.2	50.4	18	1.67	.11
9	43.8	49.0	18	-1.06	.30	47.7	52.8	18	-.88	.39

* MEAN = 50, STANDARD DEVIATION = 10

5

TABLE 7.20

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #7)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	43.5	50.7	18	-.69	.50	54.5	50.2	18	.90	.38
2	48.4	52.0	18	-1.05	.31	52.8	50.2	18	.76	.46
3	51.9	54.5	18	-.61	.55	45.6	47.3	18	-.36	.72
4	43.1	53.8	18	-2.47	.02	54.4	44.6	18	2.44	.03
5	51.5	57.0	18	-1.39	.18	50.4	53.2	18	-.79	.44
6	47.8	52.9	18	-1.68	.11	51.0	47.7	18	.90	.38
7	48.2	46.9	18	.30	.77	52.9	54.1	18	-.26	.80
8	40.9	47.2	18	-1.22	.24	50.0	51.2	18	-.25	.81
9	48.2	52.7	18	-.83	.42	53.3	57.4	18	-1.03	.32

* MEAN = 50, STANDARD DEVIATION = 10

It is also interesting to note that, with the exception of one concept, the NMO group had consistently better mean scores than the MO group at TIME 1. This was slightly improved at TIME 2 but the NMO group had still better mean scores for five concepts.

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.21 shows the test results for all three grades at TIME 1 and TIME 2. The NMO group has a significantly better mean score for all three grades at TIME 1. While the MO group had slightly better scores at TIME 2, the NMO group showed still higher mean scores for all three grades. These differences, however, were not significant at TIME 2. Thus the null hypothesis was rejected at TIME 1 but not at TIME 2.

12. Teacher's Recommendations: The three teachers at this school made the following recommendations:

a) More ideas and suggestions should be made available to teachers teaching mathematics option.

b) Class sizes in mathematics option should not exceed 15 students per class.

c) A math lab containing the necessary resources and equipment for mathematics option should be made available to students. The emphasis should be placed on providing a rich mathematical environment to students.

TABLE 7.21

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #7)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
7	8.9	15.8	18	-.474	.0002	9.1	13.7	18	-1.99	.06
8	7.8	12.7	18	-2.34	.03	12.3	12.7	18	-.15	.88
9	8.7	14.8	18	-2.41	.03	12.2	13.2	18	-.43	.67

SCHOOL EIGHT

1. General Comments: This is a twenty-two teacher school and accommodates grades one to nine. It is located in Southern Alberta in the community of Coaldale. Most of the students come from the community and their socio-economic background is considered average and above average.

2. Teacher: This teacher finds mathematics option very interesting and more challenging than most core subjects. He has taught for a total of six years and mathematics option for the last five. His academic background includes nine mathematics courses and two curriculum and instruction courses in mathematics. It was his own personal choice to teach mathematics option and with his experience and background he feels more than adequately prepared to teach it.

3. Type of Program: It is primarily an enrichment program with special emphasis on the following topics.

1. Geometry
    a. Line designs
    b. String designs
    c. Tangrams
    d. Polyhedra
    e. Creative construction
2. Number Theory
3. Algebra (Cryptarithmetic)
4. Mathematical Games
    a. Krypto
    b. Numo
    c. Ranko
5. Stock Market

Every attempt is made to avoid substantial overlap of mathematics option content with core mathematics content. This was also confirmed by the students who indicated that the overlap of content occurs only sometimes (36.7%) or very little of the time (56.7%). Students have also considerable input in developing activities for the option. While the students provide many suggestions and ideas, the teacher develops activities based on these suggestions. All students indicated that they liked this course.

4. Instructional Modes: Small groups or individual students worked most frequently on the various activities in this program. Teacher lectures were rarely used. The student responses seem to agree with the above statements.

5. Time Allotment and Program Length: It was indicated that three forty minute periods per week would be sufficient for a full year course. Approximately 97% of the students agreed that this was enough time for mathematics option. As far as the program length was concerned, the teacher would rather see mathematics option semestered.

6. Materials and Facilities: According to the teacher there was a lack of facilities only. No major problems were experienced with materials and resources. When the students were asked about this point, 60% indicated that they always had enough, 30% were unsure, and 10% indicated that there was a lack of materials and facilities.

7. Class Sizes: Between 26 and 30 students were enrolled in the mathematics option classes.

8. Objectives of Mathematics Option: This program aimed at three objectives.

   1. to create more interest in mathematics
   2. to improve, through an unstructured approach, the basics of

mathematics

3. to develop the students' creativity

The student responses seem to indicate that the majority of the students (80%) have understood these objectives.

9. Student Assignment to Option: The teacher explained that all students have the freedom to choose the option courses of their choice. Student responses revealed that approximately 93% had chosen mathematics option on their own. 63% of these students chose mathematics option because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The grade 7 test results are shown in TABLE 7.22. Significant differences in mean score at the .05 level occurred for four concepts. The mean scores of only one of these four concepts ("My Classmates are") was in favor of the MO groups. Although the mean scores were not all significantly different at TIME 1, the NMO group had a higher mean score for seven out of nine concepts. At TIME 2, only concept #2 ("My Math Teacher is") produced a significant difference in mean score. This time it was in favor of the MO group. In fact, the mean score at TIME 2 for the MO group is slightly higher for all but two concepts (3,7).

The test results for grade 8 are shown in TABLE 7.23. The mean scores for concepts #2,3,4,5 and 8 are all in favor of the NMO group, but only concepts #3 and 5 produced significant differences at the .05 level.

Significant differences between mean scores for the two groups occurred on three concepts at TIME 2. The mean scores for concept #6 ("My Math Class is") were significantly different in favor of the MO group.

TABLE 7.22

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #8)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	54.3	50.0	18	1.18	.25	51.4	49.7	18	.73	.48
2	45.0	55.6	18	-2.63	.02	45.9	40.6	18	2.48	.02
3	47.9	50.4	18	-.55	.59	53.4	54.5	18	-.23	.82
4	47.2	53.1	18	-1.29	.21	49.1	41.2	18	2.02	.06
5	44.9	53.4	18	-2.11	.05	53.2	51.1	18	.66	.52
6	48.2	54.5	18	-1.62	.12	44.5	42.1	18	.77	.45
7	56.6	45.1	18	2.83	.01	51.6	54.8	18	-.95	.36
8	44.8	57.3	18	-2.90	.01	51.3	48.7	18	.49	.63
9	45.0	54.8	18	-1.86	.08	52.0	47.9	18	.82	.42

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.23

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #8)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	56.2	51.1	18	1.60	.13	45.7	49.7	18	-1.12	.28
2	50.2	52.5	18	-.78	.44	51.0	47.4	18	1.30	.21
3	44.3	52.9	18	-2.89	.01	49.5	45.6	18	.68	.51
4	48.6	53.2	18	-1.27	.22	55.9	47.9	18	1.60	.13
5	45.5	53.0	18	-2.09	.05	44.3	49.2	18	-1.16	.26
6	51.2	50.7	18	.14	.89	52.4	45.1	18	2.65	.02
7	54.7	53.2	18	.32	.76	40.6	51.0	18	-2.11	.05
8	50.2	53.2	18	-.84	.41	43.1	49.6	18	-1.85	.08
9	51.2	50.5	18	.15	.88	43.9	54.5	18	-2.42	.03

* MEAN = 50, STANDARD DEVIATION = 10

Concepts #7 and 9 ("My Classmates are" and "Math Homework is") produced also significant differences in mean scores but this time in favor of the NMO group.

TABLE 7.24 shows the test results for grade 9. None of the mean scores were significantly different at TIME 1. It is, however, interesting to note that the NMO group had higher mean scores for seven out of nine concepts. The NMO groups had also higher mean scores for seven concepts at TIME 2. Two of these seven mean scores were significantly better than those of the MO group.

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.25 shows the test results for all three grades at TIME 1 and TIME 2. No significant differences in mean score existed for the three grades at TIME 1. Thus the null hypothesis was not rejected. A significant difference in mean score for grade seven was produced at TIME 2. The mean scores for grade 8 and 9 at TIME 2 were not significantly different at the .05 level.

The data seem to indicate that the teacher was able to develop somewhat the creative ability of mathematics option students. While the mean scores for the NMO groups remained relatively stable from TIME 1 to TIME 2, the MO groups showed considerable growth over the same time period.

12. Teacher's Recommendations: Three recommendations were made by this teacher.

a. There should be no structure imposed by the Department of Education, but more assistance in terms of suggestions and ideas should be provided.

TABLE 7.24

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #8)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	49.8	53.7	18	-.91	.38	47.8	56.3	18	-2.24	.04
2	47.2	49.2	18	-.44	.67	48.7	48.6	18	.02	.98
3	47.2	51.0	18	-.77	.45	54.1	48.7	18	1.37	.19
4	50.9	49.0	18	.60	.56	48.4	51.9	18	-1.04	.31
5	46.7	49.4	18	-.70	.50	42.7	45.8	18	-.64	.53
6	48.4	49.9	18	-.41	.68	48.6	53.3	18	-1.25	.23
7	51.8	54.3	18	-.48	.64	47.2	49.9	18	-.63	.54
8	50.6	47.7	18	1.14	.27	45.8	52.4	18	-2.21	.04
9	49.5	49.8	18	-.11	.91	45.4	50.6	18	-1.60	.13

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.25

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #8)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
7	10.2	9.9	18	.19	.85	15.1	8.2	18	3.21	.005
8	8.3	9.4	18	-.77	.45	13.1	7.5	18	1.89	.07
9	9.1	14.4	18	-1.82	.09	13.0	13.0	18	.00	1.00

b) That each mathematics option teacher prepares one activity for mathematics option and submits it to a selected group of people who would be responsible for the compilation of these ideas. This booklet should then be made available to all mathematics option teachers.

c) More money should be made available to schools offering mathematics option. Different classes will not necessarily use the same materials thus making it extremely costly for the school to acquire adequate mathematics option materials for ten different classes.

d) Lower student-teacher ratios are essential if the course is to become useful. Teachers must also get more opportunity to help and participate in individual projects and activities. This type of course also requires a great deal of preparation time.

SCHOOL NINE

1. General Comments: This school is located in the City of Medicine Hat and has a staff of 45 teachers. It accommodates approximately 850 students with about 500 students in grades seven to nine and 350 students in grades ten to twelve. Nearly all of the students come from families with average socio-economic status and income.

2. Teachers: Two teachers were interviewed at this school. The grade seven teacher offered a remedial program in mathematics option. She taught this course as a result of personal choice and enjoyed teaching it. All of her three years teaching experience were spent at the junior high school level. This was her second year in the mathematics option. Her academic background included four mathematics courses and one curriculum and instruction course in mathematics. She considers herself adequately prepared to teach this mathematics option course.

The grade nine teacher did not choose to teach mathematics option but rather was assigned by the principal to teach it. He also had three years of teaching experience which were all spent at the junior high school level. For the last two years now he has taught mathematics option. He has taken three mathematics courses but had no curriculum and instruction courses in mathematics. Because of this lack of curriculum and instruction courses he felt inadequately prepared to teach mathematics option.

3. Type of Program: The grade seven students received a remedial program which dealt with very basic concepts. Some of these are:

1. Fractions
2. Decimals

3. Percent
4. Using money etc.

The topics and activities were totally prescribed by the teacher and students had no input in structuring their mathematics option program.

The grade nine program was considered to be an enrichment course allowing the students to pursue in depth topics from the core mathematics program. Some of these topics were:

1. Number system
2. Polynomials
3. Exponents
4. Graphing
5. Geometry (plane & solid) etc.

Again, the topics investigated were rigidly prescribed. However, particular weaknesses of students were taken into account. The extent to which students were allowed to participate in the planning of the program was only in as far as identifying problem areas in which they needed additional practice. The student responses indicate that both programs have substantial overlap of content with core mathematics.

4. Instructional Modes: The teacher in grade seven emphasised individual student work with as much teacher assistance as was possible.

In grade nine, the teacher tried as often as possible to interact with the whole class through discussions and questioning. Lecturing to students which then resulted in a discussion on the lecture were also used from time to time.

5. Time Allotment and Program Length: The grade seven teacher indicated that the students required five forty-minute periods per week for the whole year. Three forty-minute periods per week were considered sufficient by the grade nine teacher. Also the students in both grades indicated that they had enough time for the mathematics option. Both teachers seemed to prefer the semestered mathematics option course.

6. Materials and Facilities: According to the teachers there were no problems with resources, materials and facilities at this school. The students responses do not strongly support this judgment. While 65% of the students indicated that they always had enough materials and facilities for projects in mathematics option, 17% were unsure and nearly 18% reported a lack of materials and facilities.

7. Class Size: Both teachers had classes ranging in size between 15 and 20 students.

8. Objectives of Mathematics Option: There was only one objective in the grade seven mathematics option -- to improve the students' basic mathematical skills. The objectives of the grade nine program were

   a. to increase basic mathematical skills
   b. to develop in students an enquiring attitude in mathematics
   c. to expose students to realistic problems in life and to provide them with the opportunity to apply the concepts to these problems

9. Student Assignment to Option: The teachers indicated that students were free to choose all of their options. Many, however, seek the advise of the school counsellor when selecting an option. Also over 80% of the students indicated that taking the mathematics option was indeed their

own free choice. The reasons for choosing mathematics option varied greatly among students. Only 35% chose it because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The test results for grade seven are shown in TABLE 7.26. No significant differences in mean scores existed between the two groups at TIME 1. However, the NMO group had a slightly better attitude toward five out of nine concepts. At TIME 2 only concept #5 ("My School") showed a significant difference in mean score between the two groups. The MO group had a significantly better attitude toward their school. All other concepts showed no significant difference in mean score. The NMO group had again a slightly better attitude toward five out of nine concepts at TIME 2.

TABLE 7.27 shows the test results for grade nine students. Only concept #7 ("My Classmates are") produced a significant difference in mean score between the MO and NMO group. The NMO group had a significantly higher mean score for that concept. Except for concepts #1 and #2, the NMO group had a higher mean score for all other concepts at TIME 1.

At TIME 2 no significant differences existed between the mean scores of these two groups. The NMO group, however, had a slightly better mean score toward five out of nine concepts.

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The test results are shown in TABLE 7.28. Significant differences were found between the MO group and NMO group for grade seven and grade nine. The NMO group for grade seven and grade nine had a significantly

TABLE 7.26

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #9)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	52.8	48.7	18	1.02	.32	50.1	53.1	16	-.62	.55
2	55.4	54.8	18	.25	.80	44.6	48.2	16	-.96	.35
3	52.4	55.2	18	-.63	.54	47.3	43.9	16	.76	.46
4	48.2	52.2	18	-1.02	.32	51.7	47.4	16	1.01	.33
5	49.8	51.2	18	-.41	.69	57.4	47.8	16	2.20	.04
6	52.8	56.8	18	-1.12	.28	46.9	43.9	16	1.56	.14
7	46.9	46.5	18	.11	.91	51.3	55.2	16	-1.39	.18
8	51.2	54.4	18	-.97	.34	46.6	52.2	16	-1.35	.20
9	48.9	48.6	18	.10	.92	47.9	54.9	16	-2.00	.06

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.27

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO)
AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #9)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	50.4	48.3	18	.47	.64	47.6	49.3	14	-.31	.76
2	47.6	44.0	18	.70	.50	50.8	52.7	14	-.60	.56
3	48.6	48.7	18	-.03	.98	49.4	58.5	14	-1.65	.12
4	42.3	46.5	18	-.87	.40	56.0	51.7	14	.79	.44
5	40.7	42.6	18	-.32	.75	45.1	46.6	14	-.25	.81
6	41.3	47.2	18	-1.11	.28	52.1	53.8	14	-.39	.71
7	35.6	49.9	18	-2.78	.01	47.8	44.7	14	.60	.56
8	45.2	48.6	18	-.60	.56	46.8	41.0	14	.84	.41
9	40.4	45.7	18	-.98	.34	47.3	44.0	14	.57	.58

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.28

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #9)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
7	7.9	13.0	16	-2.28	.04	14.9	19.2	16	-1.99	.06
9	11.3	15.3	14	-2.47	.03	8.1	15.5	14	-3.82	.002

higher mean at TIME 1 and TIME 2. The null hypothesis was therefore rejected for both grades.

12. Teacher's Recommendations: Three recommendations were made with regard to mathematics option.

a) That the Department of Education does not impose any structure on mathematics option.

b) That a resource center be established which is easily accessible to all teachers.

c) That enrolments per mathematics option class do not exceed 15 students.

SCHOOL TEN

1. General Comments: This 34 teacher school is located in the town of Hinton and accommodates grades eight to twelve. The school has a population of approximately 650 students with 350 enrolled in junior high. All students live in the community or in the very immediate area and they come from fairly affluent homes.

2. Teacher: Mathematics option is taught by this teacher as a result of personal choice. He had offered this course in the previous year for the first time and now enjoys it more than core mathematics. All of his eleven years of teaching experience were spent at the junior high school level. With his 4 mathematics courses and 2 curriculum and instruction courses in mathematics he feels quite adequately prepared to teach this course.

3. Type of Program: It was described as an enrichment program. The topics are to a large extent a continuation of the topics from core mathematics. Some of these topics are listed below.

   1. Bases and Numeration Systems
   2. Logarithm
   3. Slide Rule
   4. Geometry
   5. Problem Solving - a formal approach
   6. Mathematical Games and Puzzles

   Students participate extensively in structuring this course. Discussions and a questionnaire provide plenty of opportunity for students to have input. The questionnaire ascertains such information as (1) the students own ability in math as self-evaluated, (2) likes and dislikes in mathematics, (3) the amount of structure in the course, (4) what topics and how to deal with them, and (5) the objectives. These responses combined with the teacher's own ideas provide then the framework for this course. This thorough groundwork is probably the reason why only 20% of the students felt that there was substantial overlap of content with core mathematics.

4. Instructional Modes: The teacher and the students both indicated that the small group approach is used most frequently. A combination of lecture approach and some audio-visual presentation is also used to a large extent. Students also work on individual projects but this is done to a far lesser degree.

5. Time Allotment and Program Length: Two forty-minute periods per week were considered for a full year course. His preference, however, was that mathematics option be offered on a semester basis. From the student responses it appears that students want to spend more time in mathematics option. Only 40% indicated that they had sufficient time per week, 40% did not have enough time, and 20% were undecided.

6. Materials and Facilities: While the teacher indicated that there were no problems at all, the students seemed to have had some reservations. Only 40% of the students said that they always had enough materials and facilities for projects in mathematics option. 40% were undecided and 20% indicated a lack of materials and facilities in mathematics option.

7. Class Sizes: There were between 26 and 30 students enrolled in his mathematics option class.

8. Objectives of Mathematics Option: Three objectives were stated by this teacher. They were:

a. To create greater interest in mathematics

b. To increase the students' level of achievement in the regular mathematics program.

c. To demonstrate the value of mathematics.

When the students were asked how clear these objectives were to them, 80% responded that they clearly understood them and 20% were somewhat in doubt about their understanding of these objectives.

9. Student Assignment to Option: The teacher pointed out that all students have the freedom to choose their options. This was confirmed by the students. All of the mathematics option students sampled indicated that taking mathematics option was their own free choice. However, only 50% took it because of their interest in mathematics.

10. Attitude of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

TABLE 7.29 shows the test results. Only concept #3 (Myself) produced a significant difference in mean score between the MO group and NMO group at TIME 1. The N MO group had a significantly better self-concept. At TIME 2 there were four concepts (My Math Teacher Is, Myself, My Math Class Is, and My Classmates Are) which produced significant differences in mean score between the two groups. The MO group had a significantly better attitude toward their Math Teacher, Themselves, and Their Math Class. The NMO group had a significantly better attitude toward Their Classmates.

TABLE 7.29

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #10)

CONCEPT NUMBER	MEAN SCORE* TIME 1					MEAN SCORE* TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
1	50.0	50.1	18	-.03	.98	52.0	47.1	18	1.26	.22
2	57.8	59.6	18	-1.01	.32	47.0	41.4	18	2.21	.04
3	49.5	57.7	18	-2.84	.01	56.2	46.6	18	2.62	.02
4	53.0	55.0	18	-.46	.65	47.0	45.7	18	.41	.68
5	53.3	49.4	18	1.61	.13	53.8	55.5	18	-.61	.55
6	55.1	57.5	18	-1.08	.30	48.8	42.1	18	2.43	.03
7	54.2	47.6	18	1.49	.15	50.5	55.6	18	-2.13	.05
8	56.2	53.7	18	1.26	.22	56.3	53.2	18	.91	.37
9	55.7	55.6	18	.04	.97	55.2	56.2	18	-.27	.79

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.30

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AND NON-MATHEMATICS OPTION GROUP (NMO) AT TIME 1 AND TIME 2

(SCHOOL #10)

GRADE	GRADE MEAN TIME 1					GRADE MEAN TIME 2				
	MO	NMO	df	t	p (two-tailed)	MO	NMO	df	t	p (two-tailed)
9	12.1	15.6	18	-1.95	.07	14.0	22.9	18	-3.30	.004

11. Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The results in TABLE 7.30 indicate that the NMO group had a considerably better mean score than the MO group, but it was not significant at the .05 level. The mean scores at TIME 2 were highly significant in favor of the NMO group. Further examination of the data reveals that the MO group gained only 2 points in mean score from TIME 1 to TIME 2, while the NMO group showed a gain of over 7 points during the same time period.

12. Teacher's Recommendations: The following recommendations were made by this teacher:

a) The Department of Education should impose some structure on the mathematics option program. A range of topics should be provided from which teachers must choose a certain number for inclusion in their mathematics option program.

b) That mathematics option teachers be given much greater opportunity to meet with other teachers for the purpose of exchanging ideas and developing new activities.

c) That mathematics option teachers be provided with a book of ideas and suggestions.

SCHOOL ELEVEN

1. General Comments: This school is situated in the town of Rocky Mountain House. The 32 teachers offer programs from grade seven to twelve. Approximately 450 out of the 750 students attend junior high and the remainder is in senior high. Just about one-half of the students come from the surrounding rural area and the other one-half come from the community itself. The majority of the parents work for oil companies and the lumber industry. A small percentage of the parents are farmers. Students from all socio-economic levels attend this school. A considerable number of students come from broken homes or families on social welfare.

2. Teachers: Three teachers were interviewed at this school. The grade seven teacher taught mathematics option as a result of personal choice for the last three years. She spent all of her 7 years teaching experience at the junior high school level. Her academic background includes only one mathematics course. This is why she feels inadequately prepared to teach mathematics option. Her insufficient background makes the development of good mathematics option activities very difficult.

The grade eight teacher taught a total of 7 years of which 6 years were spent at the junior high school level and 3 years in mathematics option. It was not her personal choice to teach mathematics option. With her one mathematics course and one curriculum and instruction course in mathematics she feels adequately prepared to teach mathematics option.

The grade nine teacher spent all of his 6 years of teaching experience at the junior high school level. It was his personal choice toteach mathematics option for the last four years.

The mathematical background of this teacher include five mathematics courses and one curriculum and instruction course in mathematics. He indicated that he feels adequately prepared to teach mathematics option but becomes extremely frustrated at the lack of equipment and a proper room for mathematics option.

3. Type of Program: The programs offered to all three grade levels are primarily remedial programs with some enrichment. All junior high school students are required to take mathematics option which is in nearly all cases taught by the regular mathematics teacher. During the time allotted for mathematics option the teachers often carry on with activities from core mathematics. Only when time permits do students engage in mathematics option activities.

Below are some of the activities in which students engaged during mathematics option classes.

Grade Seven: 1. Basic drills in arithmetic by using games, such as: Krypto, Math Match, Prime Drag, etc.

2. Geometry

a) Line designs
b) Geometric constructions

Grade Eight: 1. Math games and activities to enrich regular math

2. Slide Rule

3. Geometry

a) Geo-boards
b) Geometric constructions

Grade Nine: 1. Remedial work in regular mathematics

2. Probability

3. Math games and puzzles

4. Geometry

5. Stock market

In grade seven, students had no input in structuring the option. At the grade eight level it was the students' attitude toward an activity that determined the depth in which it was pursued. Grade nine students were given the opportunity to suggest activities of interest to them which were then included in the program.

From the statements made by the teachers one would suspect considerable content overlap with core mathematics. Only 25% of the students indicated that it was substantial and 55% indicated that it occurred only sometimes.

4. Instructional Modes: There was little variation in approach between the three teachers. At the grade seven and eight level the students were given many activity sheets or workbooks on which each student worked individually. Classes were divided into small groups on days when mathematical games were played or puzzles were solved.

A similar approach was used at the grade nine level. However, in addition to the above approaches the teacher introduced students to the research method. Students were exposed to a number of reference books in pursuit of finding an answer to the question at hand.

5. Time Allotment and Program Length: Two forty-minute periods per week were considered sufficient by all three teachers for a full year course. Close to 60% of the students agreed to that, but the other students were either undecided or else they disagreed. While the grade seven teacher suggested semestering would be best for mathematics option, the grade eight and nine teachers preferred it to be a full-year course.

6. Materials and Facilities: The grade seven teacher expressed a lack of materials for mathematics option. There were no problems at all for

the grade eight program. The most severe problem in grade nine was the lack of a proper room and equipment.

Only about 40% of the students felt that they always had enough materials and facilities for projects in mathematics option. All others either indicated a lack of materials and facilities or they were uncertain.

7. Class Sizes: The grade seven class had over 30 students enrolled in mathematics option. In grade eight and nine there were between 26 and 30 students per class.

8. Objectives of Mathematics Option: All three teachers had the objective to demonstrate to students that mathematics can be fun. In addition, the grade eight wanted to develop more positive attitudes toward mathematics.

9. Student Assignment to Option: As was said earlier, all junior high students were required to take mathematics option. In most cases it was the core mathematics teacher who taught mathematics option to the same class. Despite the course being compulsory, there were still 17% of the students who claimed that it was their own personal choice to take mathematics option. Only 31% indicated that they were interested in mathematics option.

10. Attitude of Mathematics Option Students (MO): The absence of NMO groups in TABLES 7.31 to 7.34 is due to the fact that all junior high school students were enrolled in mathematics option. TABLE 7.31, 7.32, and 7.33 show the test results for grade seven,eight, and nine, respectively. Although a comparison of mean scores with the NMO group

TABLE 7.31

GRADE 7 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AT TIME 1 AND TIME 2

(SCHOOL #11)

CONCEPT NUMBER	MEAN SCORE* TIME 1 MO	TIME 2 MO
1	48.6	49.7
2	58.1	40.4
3	48.1	47.9
4	59.3	42.3
5	54.7	50.5
6	57.6	43.9
7	51.0	50.2
8	58.5	54.6
9	55.6	55.5

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.32

GRADE 8 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AT TIME 1 AND TIME 2

(SCHOOL # 11)

CONCEPT NUMBER	MEAN SCORE* TIME 1 MO	TIME 2 MO
1	49.5	48.9
2	55.6	45.4
3	54.3	54.5
4	60.3	40.6
5	52.4	58.4
6	57.4	43.2
7	53.5	51.7
8	59.4	52.3
9	59.7	53.1

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.33

GRADE 9 MEAN EVALUATIVE SCORE FOR MATHEMATICS OPTION GROUP (MO) AT TIME 1 AND TIME 2

(SCHOOL # 11)

CONCEPT NUMBER	MEAN SCORE* TIME 1 MO	TIME 2 MO
1	50.2	52.1
2	56.0	44.3
3	52.3	55.6
4	54.7	46.7
5	49.1	54.0
6	58.6	43.5
7	52.3	56.6
8	52.0	50.2
9	49.4	49.8

* MEAN = 50, STANDARD DEVIATION = 10

TABLE 7.34

MEAN SCORES ON CREATIVITY TEST IN MATHEMATICS FOR MATHEMATICS OPTION GROUP (MO) AT TIME 1 AND TIME 2

(SCHOOL # 11)

GRADE	GRADE MEAN TIME 1 MO	TIME 2 MO
7	12.3	12.4
8	14.9	14.7
9	18.5	19.3

was not possible, it was still considered important to include these results in this section. The interested reader might want to compare these mean scores with the mean scores of other MO groups from different schools.

11. Creativity of Mathematics Option Students (MO): The test results for all three grades are shown in TABLE 7.34. It is interesting to note that the grade seven score at TIME 1 is the highest of all participating grade seven groups. At TIME 2 the mean score ranks fourth from the top. Similar observations were made for grade eight students. The score of 14.9 at TIME 1 is the highest of 9 grade eight MO groups. At TIME 2 it ties with another school for the highest mean score of all participating grade eight MO groups.

There were a total of seven grade nine MO groups from 7 different schools. Again, 18.5 was the highest score and only one other school had the same score. The performance of the grade nine MO group at TIME 2 was the highest of all 7 grade nine MO groups participating.

TABLE 7.34 also reveals that there was very little change in mean score from TIME 1 to TIME 2 for all three grades.

12. Teacher's Recommendations: A number of recommendations were made by these three teachers. Some are clearly aiming at the provincial level and others more at the school level. They are as follows:

a) The Department of Education should provide a list of topics to be covered at each grade level.

b) The periods intended for mathematics option should be used for remedial purposes or enrichment in regular mathematics.

c) In order to be effective, the enrolments per class in mathematics option should not exceed 15 students.

d) Mathematics option should be taught in a room where resources, materials and equipment are readily available for that purpose.

e) Teachers should not be assigned to mathematics option but rather selected on a basis of personal choice.

CHAPTER VIII

JUDGMENT
AND
SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Introduction

This final chapter is comprised of five major sections. In the first section, the investigator passes judgment with regard to the congruence of observations with intents and observations with standards. A summary of the conclusions about the congruence analysis is included in section two. The third section contains a summary of the conclusions about the contingency analysis. Section four passes judgment with regard to the analyses by school (CHAPTER VII). The last section contains the recommendations which were based on the conclusions from the previous sections and chapters.

Judgment with Regard to Congruence

Observations with Intents

The Mathematics Option Teacher: The observations and intents are only moderately congruent. While the teachers appear to be strong in terms of teaching experience and mathematics background, there were other important intents which were obviously not met. For example, teachers had relatively little background in curriculum and instruction courses. This might have been a possible reason why teachers find the development of mathematics option programs difficult. It was also intended that teachers are knowledgeable with regards to the philosophy, objectives and framework of mathematics option. There is considerable evidence that the whole philosophy of mathematics option has been missed by a considerable number of teachers. Some use mathematics option for remedial instruction, others as time fillers and still others use it as an extension of the core mathematics program.

If one can assume that teachers are capable of assessing their own knowledge and ability, then closer attention must be paid to the assignment of teachers to mathematics option. Nearly one-half of the teachers felt that there were better qualified teachers on staff to teach mathematics option.

The Mathematics Option Student: The findings about the mathematics option students seem to point at a lack of congruence between intents and observations. Students are not selected on the basis of strength and nearly one-half of the students are not in mathematics option by choice. This, undoubtedly, leads to difficulties for both, teachers and students. While the teachers find it difficult to cope with such a wide variety of interests and abilities, the students often experience increased frustration and eventually give up.

The Nature of the Mathematics Option Curriculum: Four different types of programs were offered and only the remedial program, which was offered by nearly one-fifth of the teachers, was not consistent with the philosophy of the mathematics option. It was also intended that students should be given the opportunity to contribute to the selection of learning experiences. Just over one-half of the teachers provided a chance for student input. This can not be considered congruent with the intents. Far greater congruence was found between the observed and intended content overlap of mathematics option with core mathematics.

While it was considered important to utilize resources of the community and environment in mathematics option, it was found that these were rarely used and then only to a limited intent.

In general, most teachers have imposed a fairly rigid structure on their program, but the majority felt that they provided a program for the needs, interests and abilities of most students. The observations can be described as moderately congruent with the intents in the area of the mathematics option curriculum.

Materials and Facilities: It was intended to offer mathematics option only where resources permit. This meant that the teachers and administrators had the responsibility to assess the resources of the school and community before offering mathematics option. If it can be assumed that the items in the questionnaire, which were being assessed, were of some importance in the various programs throughout Alberta, then they received rather low ratings by the teachers. This would clearly point to an incongruence between intents and observations.

Instructional Activities: It was intended to emphasize individualized instruction, library research, math-lab experiments and field trips, depending upon the nature and the object of the learning experience.

Teacher responses indicated that paper-pencil activities in the form of worksheets were by far the most dominating in the mathematics option class. Individual projects and class discussions ranked second and third, respectively.

It would appear that the nature of mathematics option would lend itself to a wide variety of teacher-learner activities, but it may be said that a very limited repertoire of learning activities pervades the mathematics option classroom. Thus the intents were not congruent with the observations.

Time Allotment: It was evident from the responses that teachers had sufficient time. The majority of the teachers scheduled two to four forty minute periods per week for a full year course. This is in total agreement with the intents.

It was also found that most teachers offer mathematics option as a full year course. The suggestion to use modular scheduling was almost completely ignored. Probably for no other reason than the additional difficulties it creates in developing a time table.

General Objectives of Mathematics Option: The intents and observations were perfectly congruent with regard to the development of positive attitudes. The other intended objectives were far from being congruent with the observations.

Effects of the Program on the Teachers: The implementation of the mathematics option program intended to allow teachers to innovate and develop their own programs. This, in turn, was to improve the level of satisfaction among teachers who were, up to now, only teaching according to a prescribed course outline.

The observations revealed that teachers were involved in all kinds of planning for the option at the local level. While the majority of the teachers wished to cintinue to develop their own programs, there was, however, an increased demand to receive more assistance in terms of ideas and suggestions. It must further be noted that enrollments in mathematics option were too high and teachers received little preparation and planning time. In addition, a large number of students did not want mathematics option nor did they have any interest in mathematics. Despite the observations, teachers indicated that mathematics option had achieved an adequate level of satisfaction among them.

Observations with Standards

The Mathematics Option Teacher: The degree of congruence of observations with standards was examined in four different areas. The observed teaching experience for mathematics option teachers was adequate. More than 90% of the teachers met the established standard. The majority of the teachers also met the standard for the mathematics background. In fact, a considerable number of teachers had a mathematics background better than the established standard. Slightly over 80% of the teachers also met the standard for curriculum and instruction courses. The observed assignment procedures and the standard for assigning teachers were highly incongruent. Teachersindicated that they wished to teach mathematics option on a voluntary basis. The method of teacher/principal consultation whereby training in mathematics and teaching experience in junior high would be taken into account, was also acceptable to teachers.

The Mathematics Option Student: The observations and standards were not congruent in the area of student selection for mathematics option. Only 52% of the teachers indicated that it was the students' personal choice to select mathematics option. Nearly 80% felt that it should be the students' own choice.

It was also not surprising that the majority of the teachers taught heterogeneous classes with respect to mathematical ability.

This, no doubt, is directly related to the inadequate assignment procedures of students to mathematics option. While homogeneous grouping is not always feasible at the school level, it is important that more attention is being paid to this incongruence in the future.

Over 80% of the teachers felt that mathematics option students should have a positive attitude toward mathematics. The observations are far from being congruent with the standards. Less than 30% of the teachers indicated that their students had a positive attitude toward mathematics. It was evident that most classes consisted of students with a wide range of abilities in and attitudes toward mathematics. The standard set by teachers was that mathematics option students have a better attitude toward mathematics, have greater ability and are more creative in mathematics than non-mathematics option students. Again, the observations were not congruent with these standards. The claim,that there were no differences in attitude and ability between mathematics option students and non-mathematics option students, was made by nearly 40% of the teachers.

Complete agreement between observations and standards was found with regard to the grade level at which mathematics option should be taught. Teachers do teach it and prefer it to be taught in grade seven, eight, and nine.

The Nature of the Mathematics Option Curriculum: Six questions were raised with regard to the nature of the mathematics option curriculum. They dealt with (1) the types of mathematics option programs, (2) the extent to which students contribute to the selection of curricular content in mathematics option, (3) the ways students help to structure the mathematics option program, (4) the amount of overlap of mathematics option content with core mathematics content, (5) the extent to which resources of the community and environment are included to demonstrate applications of mathematics, and (6) the extent to which the mathematics option program in Alberta should be structured.

The observed types of mathematics option programs and the standards were significantly different. This incongruence was due to the fact that teachers would have liked to see remedial courses deemphasized and courses that provided for individual interests and abilities emphasized in the mathematics option classroom.

The observations with regard to the extent to which students contributed to the selection of curricular content in mathematics option were significantly different from the standards. The standards seem to suggest that teachers recognize the importance of student participation in content development for the option. The observations, however, were far from being satisfactory.

The observations, with regard to how students helped to structure the mathematics option program, were also incongruent with the standards. Teachers wanted greater emphasis be placed on the method whereby the student's own suggestions should be used to plan an individual program for that student. The standards also indicated that fewer teachers than observed should have the attitude that the lack of background does not permit students to help.

The standard for content overlap of mathematics option with core mathematics was stated to be at most moderate. While most teachers had met the standard, the observations were still incongruent with the standard. There is all indication that, no matter what teachers observed the overlap to be, the trend is to have moderate or as little content overlap as possible.

Resources from the community and environment should play an important role in mathematics option. But, again, the observations and standards were not congruent. Teachers strongly suggested that community resources should be frequently used in mathematics option, but the observations indicated that few teachers use these only sometimes.

The last question dealt with the extent to which the mathematics option program should be structured. At the time mathematics option is completely unstructured. This means, that there is no prescribed textbook, program of studies or curriculum guide. The programs in the various schools are developed at the local level to suit that specific situation. The majority of the teachers have expressed that they would like mathematics option to remain unstructured. Teachers, however, would like to see more assistance in terms of ideas and suggestions from the Department of Education.

Materials and Facilities: Based on the assumption that the materials and facilities as listed in TABLE 5.14, had some relevance in the mathematics option programs, then the observations were clearly not congruent with the established standards. The standard was that 75% of the responses had to be in the "good" and "very good" response categories combined for each of the basic items. Not only these basic items, but also all other items, which were rated by teachers, fell far below the established standard. There is the possibility that the standard was set too high, but it can hardly be argued that these items were not relevant. Examination of TABLE 4.22 supports this statement. Had the items been irrelevant in the various programs, then the teachers should have rated it one, meaning "not desirable to have".

That all is not well in the area of materials and facilities was supported by the mathematics option students in the eleven schools. Only approximately 50% of the students indicated that they always had sufficient materials and facilities for projects in mathematics option.

Instructional Activities: Important differences between observations and standards occurred for three instructional modes only (See TABLE 5.15). Examination of TABLES 4.24 and 4.54 revealed that large differences in the percentage responses occurred for each instructional mode. In general, it can be said that the most frequently observed modes represent the "traditional" approach, while the standard seems to express the teachers' desire to use activities that have been recommended. Why are teachers using paper-pencil activities to the extent they do? Is it possible that large classes, lack of preparation time, lack of material and resources make it difficult, if not impossible, to set up math-lab experiments? Maybe teachers are handling mathematics option classes as best as they can under the circumstances. Since the success or failure of mathematics option lies to a large extent in the way it is taught, it is, therefore, imperative that a climate be established that allows teachers to use a wide variety of learning activities.

Time Allotment: Three forty minute periods per week for a full year course would be sufficient. Most teachers were using 2 to 3 forty minute periods and they also felt that this would be sufficient. The mathematics option students from the eleven schools were in full agreement with the allotment of 3 forty minute periods per week.

Most schools offered mathematics option as a full-year course. The standard clearly indicated a preference for a semestered course.

Observations and standards were congruent with regard to time allotment, but they were incongruent as far as program length was concerned.

General Objectives of Mathematics Option: The performance of the mathematics option students in relation to the non-mathematics option students on the attitude test and creativity test are discussed later in this chapter.

Effects of the Program on the Teachers: Five areas were considered that might have had an effect on the teachers. The first area dealt with the amount of supervision required in mathematics option. Only moderate congruence was achieved between observations and standards. It was quite reasonable to expect that students work well with little supervision in mathematics option classes. This only happens in less than one-half of the mathematics option classrooms in Alberta. Some possible reasons for this might be the type of program offered, the assignment procedures used for students and teachers, class size, teaching strategies and many more.

Student discipline was another area of concern. Here, too, it was argued that there should be fewer discipline problems in mathematics option than in core subjects. The argument being that if students are given the freedom to choose a subject in which they are strong and if they are allowed to contribute to the content of the course, then this by itself should reduce the possibility of discipline problems in the classroom. Again, it should be recognized that there might be more factors that influence discipline problems in mathematics option than in core subjects. Observations and standards were fairly congruent.

It was argued by the investigator that teachers in mathematics option require more preparation and planning time than teachers in core subjects. The majority of the teachers agreed with this standard and indicated that they are indeed in need of more preparation and planning time. When one considers that the development of the whole program rests on the teacher's shoulder, then the request for more time is quite legitimate.

Another area of concern was the amount of physical and mental strain on mathematics option teachers. The standard read that due to the intended nature of the mathematics option program, teachers would likely experience greater mental and physical strain than teachers teaching core subjects. Only 37% of the teachers were of the opinion that this was so. Forty-five percent disagreed with this statement and 18% remained neutral. Thus, the observations can not be considered congruent with the standard.

The last area of concern was the enrollment in mathematics option classes. 50% of the teachers reported enrollments in excess of 25 students. This is by no means congruent with the established standard of 25 students per class. In fact, it is reasonable to suspect that these high enrollments might have a profound impact on the teacher's instructional mode, discipline, the amount of preparation and planning time required and the teacher's overall level of satisfaction.

There were, no doubt, more factors that had an effect on the mathematics option teacher but were not included in this study. It must be recognized that the evidence on the effect of the program on the teachers is very sketchy and provided no conclusive picture. But, whatever the impacts were on the teachers, the overall effect was positive. This was supported by the fact that two-thirds of the teachers expressed general satisfaction with the program.

Summary of Observations

This summary includes findings with regard to all variables and it also contains answers to the educational questions of CHAPTER 1 (See CHAPTER I, page 3 and 4, questions 6-16). If a conclusion is the answer to a question of CHAPTER I, then the question number is placed in brackets at the end of the conclusion.

The Mathematics Option Teacher

1. The majority of the mathematics option teachers had at least three years of teaching experience at the junior high school level. (Question 6)
2. The majority of the teachers taught mathematics option for at least one year.
3. Most teachers had an adequate mathematics background. (Question 6)
4. The majority of the teachers had a limited background in curriculum and instruction courses in mathematics.
5. There are some mathematics option teachers without any mathematics background and curriculum and instruction courses in mathematics.
6. Most teachers are assigned by the principal to teach mathematics option. (Question 6)
7. Most teachers felt they were adequately prepared to teach mathematics option.
8. The majority of the mathematics option teachers found curriculum

development in mathematics option difficult. (Question 14)

9. Nearly one-half of the teachers felt that there were better qualified teachers on staff to teach the mathematics option.
10. The majority of the teachers wanted mathematics option to remain unstructured with respect to the Department of Education course outline. More assistance in terms of ideas and suggestions was requested. (Question 14)

The Mathematics Option Student

1. Just slightly over one-half of the teachers indicated that students had a personal choice in selecting mathematics option. (Question 7)
2. Most mathematics option students are not selected on the basis of strength in mathematics. (Question 7)
3. Less than one-half of the mathematics option students chose mathematics option out of interest in mathematics.
4. The majority of the mathematics option classes were heterogeneous with respect to mathematical ability.
5. Nearly one-half of the mathematics option classes consisted of students with wide ranging abilities, interests and attitudes.
6. A large number of teachers felt that there were no differences between mathematics option students and non-mathematics option students in terms of ability and attitude toward mathematics. (Question 7)
7. From the observations it appeared that most schools had no criteria in selecting students for the mathematics option. (Question 7)
8. Most mathematics option students from the eleven schools liked their mathematics option program. (Question 15)

The Nature of the Mathematics Option Curriculum

1. The majority of the teachers offered programs consistent with the intents of mathematics option. (Question 16)
2. More than one-half of the teachers permitted students' input in structuring the mathematics option program. (Question 8)
3. Teacher and student suggestions provided a pool of activities from which a program was developed for the individual or the whole class. (Question 9)
4. There was little overlap of mathematics option content with core mathematics content for the majority of the teachers. (Question 16)
5. Limited use was made of the resources from the community and environment. (Question 16)
6. The majority of the teachers were able to provide programs for the needs, interest, and abilities of most students. (Question 16)
7. Teachers provided a fairly rigid mathematics option program. Students were not always given the opportunity to work in areas of interest to them. (Question 15)
8. Teachers were responsible to develop a curriculum for the mathematics option. (Question 14)
9. Most students wanted mathematics option to continue in its present form. (Question 15)

Materials and Facilities

1. There was a lack of references and materials for many topics included in the mathematics option curriculum. (Question 10)
2. There was a lack of proper facilities where workshops, experiments and other mathematics option activities could be pursued. (Question 10)

Instructional Activities

1. Teachers have retained the "Traditional" modes with only few new orientations. (Question 11)
2. Many useful instructional activities were completely deemphasized. (Question 11)

Time Allotment

1. Mathematics option received sufficient time. Most teachers scheduled three forty minute periods per week for a full-year course. (Question 12)
2. Most mathematics option programs were scheduled for a full year. (Question 12)

General Objectives of Mathematics Option

1. Teachers found the development of more positive attitudes toward mathematics the most important objective in this course. (Question 13)
2. To develop creative thinking in mathematics and the students' confidence in their ability ranked second and third, respectively. (Question 13)

   (See TABLE 4.31 for the rank order of objectives)

Effect of the Program on the Teachers

1. Teachers had the freedom to innovate and develop their own program. (Question 14)
2. A considerable number of students did not work as well as expected in mathematics option. (Question 14)
3. There were no more discipline problems in mathematics option than there were in core subjects. (Question 14)
4. Teachers did require more preparation and planning time in mathematics option. (Question 14)

5. A large number of teachers experienced more physical and mental strain in mathematics option than in core subjects. (Question 14)
6. The enrollments were too high in mathematics option classes. One-half of the classroooms had enrollments in excess of 25 students.
7. Teachers in mathematics option expressed general satisfaction with the program. (Question 14)

Summary of Conclusions of Contingency Analysis

In CHAPTER Vl, eight null hypotheses were tested which reflected the educational questions of CHAPTER 1 (See CHAPTER 1, page 3, questions 1-5). Each question is stated below and followed by the conclusions.

Question 1

> Is the professional and academic background of the mathematics option teacher related to the level of satisfaction in teaching the mathematics option?

Conclusions

1. Teachers with more teaching experience at the junior high school level did not experience an increase in the level of satisfaction in teaching mathematics option.
2. Teachers did not increase their level of satisfaction in mathematics option by teaching it from year to year.
3. The number of mathematics courses had no impact on the teacher's level of satisfaction in mathematics option.
4. An increase in the number of curriculum and instruction courses in mathematics had the tendency to increase the teacher's level of satisfaction in mathematics option.

Question 2

Is there any relationship between the mathematics background of the mathematics option teachers and their assignment to teach the mathematics option?

Conclusions

1. The mathematics background of the teacher is a determining factor in assigning him/her to teach mathematics option.
2. The absence of a mathematics background make teaching experience at the junior high school level the determining factor in assigning him/her to teach mathematics option.

Question 3

What is the relationship between the professional and academic background and the ability to develop a curriculum in the mathematics option?

Conclusions

1. Experienced teachers at the junior high school level do not find the development of a curriculum in mathematics less difficult than inexperienced teachers.
2. Teachers with teaching experience in mathematics option do not find the development of a curriculum in mathematics option less difficult than teachers with no experience in teaching mathematics option.
3. An increase in the number of mathematics courses had no bearing on how teachers judged their difficulties in developing a mathematics option curriculum.
4. An increase in the number of curriculum and instruction courses had no bearing on how teachers judged their difficulties in developing a mathematics option curriculum.

Question 4

Is there any relationship between the professional and academic background and the amount of overlap of the mathematics option program and the core mathematics program?

Conclusions

1. An increase in teaching experience at the junior high school level did not reduce the amount of content overlap of mathematics option with core mathematics.
2. An increase in teaching experience in mathematics option did not reduce the amount of content overlap of mathematics option with core mathematics.
3. An increase in the number of mathematics courses did not reduce the amount of content overlap of mathematics option with core mathematics.
4. An increase in the number of curriculum and instruction courses in mathematics did reduce the amount of content overlap of mathematics option with core mathematics.

Question 5

Is the ability to develop a curriculum in mathematics option related to the amount of structure that should be imposed on the mathematics option program by the Department of Education?

Conclusion

1. The teacher's level of ability to develop a curriculum in mathematics option had no bearing on the amount of structure that he/she wished imposed on the mathematics option program.

Judgment with respect to Analysis by School

In this section, the investigator passes judgment with respect to the findings of the analyses by school (CHAPTER VII). Judgment is passed for all schools collectively and covers all aspects which were included in Chapter VII. In order to be consistent with Chapter VII, it was decided to use the same sequence of presentation.

Teachers: The teaching experience of mathematics option teachers varied considerably. Teachers had from three to thirty-one years of teaching experience. In all eleven schools, the teachers had at least one year of teaching experience in mathematics option. While most teachers taught mathematics option as a result of personal choice, five teachers were assigned by the principal to teach the course. The academic background of the teachers was, in general, adequate but some teachers should consider taking additional mathematics and curriculum and instruction courses.

Type of Program: Most teachers offered an enrichment or general interest course. Both types are acceptable to the philosophy of mathematics option. In some schools, however, the course was used for remedial purposes or students received additional instruction in core mathematics during that time. Schools, which offered these two types of courses, have obviously missed the philosophy of mathematics option. It was also observed that students in these remedial classes had no input in developing activities for the option. There was also complete overlap of content of core mathematics with mathematics option.

Instructional Modes: Every effort was made to individualize the program or have students work at least in small groups. This was often difficult because of excessive enrollments. The best, students could hope for, were worksheets or other pencil and paper activities. These were easily prepared and demanded little of the teachers' time. Thus, basically the lessons began with an introduction by the teacher which were then followed by activities. This was a very common mode of instruction and it is perhaps the best one can expect under the circumstances. Instructional modes, such as math-lab experiments, library research, field trips, resource persons from community, and individual projects have been used far less than was intended.

Time Allotment and Program Length: Nearly all teachers offered mathematics option as a full-year course. The majority of the teachers, however, preferred the course to be semestered. The time allotted to mathematics option ranged between 2 and 4 forty-minute periods per week for a full-year course. Teachers and students in these eleven schools felt, that they had sufficient time.

Materials and Facilities: Nine of the eleven schools visited encountered problems with materials, resources, supplies, and facilities. In some schools materials and references were in very short supply. In other schools the teachers noted a shortage of equipment which affected their program. One teacher indicated that there was a definite upgrading of resources necessary in his school. In one school, the teachers found that the lack of space for mathematics option had a serious effect on their program.

More than one-half of the teachers interviewed remarked that an improvement in the area of materials and facilities and greater availability of resources and materials would make mathematics option a better course in the future.

Clearly, the mathematics option program is dependent for its success upon the availability of materials and resources of many forms. Unless these materials and resources become available to teachers, the programs will flounder.

Class Sizes: Most class sizes were in excess of what might be considered acceptable. There were four classes with enrollments from 15 to 20 students, four classes with 21 to 25 students, twelve classes with 26 to 30 students and five classes with more than 30 students.

The most frequent comment that was made by teachers when they made suggestions for the future was to reduce class sizes in mathematics option.

Objectives of Mathematics Option: The objectives varied from teacher to teacher which depended upon the content and nature of the programs. There were, however, a number of teachers with common objectives. The most important objectives were: (1) to improve the attitude of students toward mathematics, (2) to improve knowledge of basic concepts, (3) to develop interest in mathematics by exposing students to different mathematics, (4) to develop the students' mathematical creativity, and (5) to demonstrate the usefulness of mathematics in daily life.

The teachers, who responded to the questionnaire, found the improvement of the students' attitude toward mathematics also of utmost importance. If attitude development is to play such an important role in mathematics option, then teachers must become more aware of ways to maintain good attitudes and to improve some existing attitudes.

Student Assignment to Option: In seven out of the eleven schools the students chose mathematics option as a result of personal choice. Three schools had some restrictions in that students had only a choice of two or three options. The other options were compulsory. In one school there was no choice at all. All students had to take mathematics option and in most cases the students were taught by their core mathematics teacher. While it is not desirable to simply place students into mathematics option, the ability to choose, however, depends very much upon the size of the school.

Much can be done to give students a choice, but some teachers must be, first of all, convinced of the desirability of an option program based on the students' needs and interests.

Judging on the basis of these eleven schools, it must be said that most schools tried to give students full freedom of choice of selecting mathematics option. In some schools there was an intensive counselling program which assisted students in selecting options.

Attitude of Mathematics Option Students (MO) versus non-Mathematics (NMO) Option Students:

The performance of the NMO group was used as a standard to which the performance of the MO group was compared (See CHAPTER VII). It is the purpose of this section to pass judgment on how well the standards were met by the MO group. The discussion is presented by school.

SCHOOL ONE: MO students in grade seven seem to have met the standard at TIME 1 and TIME 2. In fact the attitude toward concept #1 (Mathematics) at TIME 2 was significantly better for the MO students. MO students in grade eight seemed to be slightly below the standard. Their attitude toward mathematics at TIME 1 is significantly below the standard. Likewise at TIME 2 where the attitude of MO students toward concept #3 (Myself) is significantly below the performance of the NMO group. There are a number of concepts at TIME 1 and TIME 2 for grade eight which show a score slightly below the standard.

SCHOOL TWO: The performance of the grade eight MO students was not different from the NMO students and therefore it met the standard for all nine concepts at TIME 1 and TIME 2.

SCHOOL THREE: No significant differences existed for grade eight students at TIME 1 and TIME 2. But, it is interesting to note, that the mean score for MO students was slightly below that of the NMO students for eight concepts at TIME 2. However, the standard was met by MO students at both times.

Grade nine MO students had also met the standard at TIME 1 and TIME 2. At TIME 2 they showed a significantly better attitude toward mathematics than the NMO group.

SCHOOL FOUR: The grade eight MO students met the standard at both times and at TIME 2 they showed a significantly better attitude toward mathematics (Concept #1) and mathematics homework (Concept #9) than the NMO students.

SCHOOL FIVE: The performance of the grade seven MO students matched that of the NMO students very well at both times. No significant difference were observed on any concept at TIME 1 and TIME 2.

MO students in grade eight were slightly below the standard. At TIME 1, their attitude toward mathematics (Concept #1) was significantly below the standard. While the differences in mean score were not significant at TIME 2, the score of the MO students was slightly below that of the NMO students for seven concepts.

Grade nine MO students had met the standard at TIME 1 and TIME 2. In fact, their attitude toward "My School" (Concept #5) at TIME 1 and "Mathematics" (Concept #1) at TIME 2 was significantly better than the standard.

SCHOOL SIX: The attitudes of the MO students and NMO students were fairly evenly matched at TIME 1. While the attitude of MO students toward mathematics (Concept #1) was significantly below the standard at TIME 1, the attitude of MO students toward "My School" (Concept #5) was significantly above the standard at TIME 1. All other concepts showed no significant difference in mean score. At TIME 2, the attitude of the MO students is slightly below the standard. First of all, the MO students have a slightly lower mean score for 6 concepts and for concept #7 (My Classmates are) the mean score is significantly below the standard.

The MO students in grade eight met the standard at TIME 1 and 2. No significant difference occurred at both times. However, the mean scores of the MO students were slightly below those of the NMO students for 6 concepts at TIME 2.

SCHOOL SEVEN: There were no significant differences in mean score at the grade seven level. Thus, grade seven MO students met the standard at TIME 1 and TIME 2.

Also grade eight MO students had met the standard at both times. There is, however, the tendency for the MO scores to be slightly below the NMO scores.

MO students in grade nine did not meet the standard at TIME 1. Not only were the MO scores slightly below the NMO scores for 8 concepts, but the attitude of the MO students was also significantly below the standard for concept #4 (Taking a Math Test is). At TIME 2, the MO students had shown considerable improvement in attitude. In fact, the attitude of MO students toward concept #4 was significantly better than the standard. There were no other significant differences in mean score at TIME 2.

SCHOOL EIGHT: Grade seven MO students did not meet the standard at TIME 1. The mean score for MO students was significantly below the standard for three concepts. They were concept #2 (My Math Teacher is), concept #5 (My School), and concept #8 (My Math Textbook is). In addition to this, MO students had a slightly lower score on four more concepts. Only toward concept #7 (My Classmates are) did the MO students have a significantly better attitude than NMO students.

The performance of the grade seven MO students at TIME 2 did meet the standard. MO students even showed a significantly better attitude toward concept #2 (My Math Teacher is) than NMO students.

The performance of the grade eight MO students were below the standard at TIME 1 and TIME 2. MO students scored significantly lower than NMO students on concept #3 (Myself) and concept #5 (My Sc**j**ool). At TIME 2, the concepts were #7 (My Classmates are) and #9 (Math Homework is).

Grade eight MO students only had a better attitude toward concept #6 (My Math Class is) at TIME 2.

Although there were no significant differences at TIME 1 for grade nine, there was the tendency, however, for the MO students to be slightly below the standard. At TIME 2, grade nine MO students were clearly below the standard. Their attitude was significantly below the standard for concept #1 (Mathematics) and concept #8 (My Math Textbook is).

SCHOOL NINE: There occurred no significant differences in mean scores for grade seven students at TIME 1. At TIME 2, MO students had a significantly better attitude toward concept #5 (My School). Grade seven MO students have at most met the standard at TIME 2.

Grade nine MO students did not meet the standard at TIME 1. Their attitude toward concept #7 (My Classmates are) was significantly below the standard. The mean scores of MO students were also slightly below the mean scores of NMO students for 6 concepts.

No significant differences were found at TIME 2. The MO students met the standard at that time.

SCHOOL TEN: The MO students in grade nine did not meet the standard at TIME 1. The attitude toward concept #3 (Myself) was significantly below the standard. The mean score of MO students for four more concepts was only slightly below the standard.

The attitude of MO students at TIME 2 was significantly better for 3 concepts. These were concept #2 (My Math Teacher is), concept #3 (Myself), and concept #6 (My Math Class is). The attitude was significantly below only toward concept #7 (My Classmates are). In general, MO students had met the standard at TIME 2.

SCHOOL ELEVEN: All students had to take mathematics option at this school. A comparison of MO students with NMO students was, therefore, not possible. The interested reader might want to compare the performance of MO students at this school with the performance of MO students at other schools.

If one can assume that the performance of the non-mathematics option students was a fair standard, then the conclusion is that most mathematics option classes have merely met the standard but not exceeded it. In fact, more than one quarter of the classes tested fell below the standard. When mathematics option students have an attitude toward mathematics and related concepts inferior to that of non-mathematics option students, then schools had better be prepared to examine all relevant factors. The assignment procedure of students, student characteristics, the teacher, the nature of the program and the instructional activities are only a few variables that might be examined.

Creativity of Mathematics Option Students (MO) versus non-Mathematics Option Students (NMO):

The performance of the NMO groups in schools were used as a standard to which the performance of the MO groups were compared (See CHAPTER VII). A significant difference in mean score at the .05 level was either below or above the standard as expressed by the performance of the NMO group. The discussion is presented by school.

SCHOOL ONE: Grade seven MO students met the standard at TIME 1 and TIME 2. In fact, their scores were slightly above the standard at both times.

Grade eight MO students had also met the standard at TIME 1 and 2. Their scores, however, were slightly below the scores of the NMO group.

SCHOOL TWO: The MO students in grade eight had met the standard both times. At TIME 1, the score was only slightly above the standard, but at TIME 2, MO group was significantly above.

SCHOOL THREE: There was no significant difference in mean score between the grade eight MO group and NMO group at TIME 1 and TIME 2. The standard was met, however, with the MO group having a slightly better score both times.

For grade nine students it was exactly the opposite. While the standard was met by the MO group both times, it was, however, slightly below the NMO's score.

SCHOOL FOUR: The standard was met by the grade eight MO group both times. The mean score of the MO group was only slightly below the mean score of the NMO group.

SCHOOL FIVE: Grade seven MO students met the standard at TIME 1 and at TIME 2 they were significantly above the standard.

Grade eight MO students met the standard at TIME 1 and 2. While the MO group was slightly above the standard at TIME 1, at TIME 2 they were below.

Grade nine MO students performed significantly above the standard at TIME 1 and TIME 2.

SCHOOL SIX: Grade seven MO students met the standard at TIME 1, but their score was slightly below it. At TIME 2, the MO group performed significantly above the standard.

Grade eight MO students were significantly above the standard at TIME 1, but only slightly above it at TIME 2.

SCHOOL SEVEN: Grade seven MO students were significantly below the standard at TIME 1. At TIME 2, they were still far below the standard but not significantly so.

Grade eight MO students were significantly below the standard at TIME 1 and only slightly below at TIME 2.

Grade nine MO students performed significantly below the standard at TIME 1 and only slightly below at TIME 2.

SCHOOL EIGHT: Grade seven MO students met the standard at TIME 1 and performed significantly above the standard at TIME 2.

Grade eight MO students met the standard at TIME 1 and TIME 2. At TIME 1, the MO group performed slightly below and at TIME 2 slightly above the standard.

Grade nine MO students had a mean score considerably lower than the standard at TIME 1, but it was not significantly lower. At TIME 2, they had identical mean scores.

SCHOOL NINE: Grade seven MO students did not meet the standard at TIME 1. At TIME 2, they were still far below the standard with $p = .06$.

Grade nine MO students performed far below the standard at TIME 1 and TIME 2.

SCHOOL TEN: At TIME 1, grade nine MO students had a mean score below the standard, but it was not significantly below. However, at TIME 2 the performance of the MO group fell significantly below the standard.

SCHOOL ELEVEN: Comparison of performance within the school was not possible since all students had to take mathematics option. But, comparison of the scores with other schools revealed that the scores are fairly high. The score of 12.3 for grade seven at TIME 1 was the highest score among all participating schools. At TIME 2, the score was 12.4 and it ranked fourth from the top.

Grade eight students had a score of 14.9 at TIME 1 and 14.7 at TIME 2. At TIME 1 it was the highest score and at TIME 2 it tied with another school for the highest score.

The scores for grade nine students were 18.5 at TIME 1 and 19.3 at TIME 2. At TIME 1 it tied with another school for the highest score and at TIME 2 it was the highest score among all participating schools.

Recommendations

The recommendations that follow were based on the observations made in previous sections. Every effort was made to have the preceding paragraph provide a link between the recommendations and findings.

Recommendations Re: The Mathematics Option Teacher

It was judged that teachers, while they were strong in terms of teaching experience and mathematics background, had some problems with mathematics option and were basically unprepared to deal with it. Hence the following recommendations:

1. That all relevant groups (Department of Education, School Board, Faculties of Education and Teachers' Association) become more deeply involved in clarifying the philosophy, objectives and framework of mathematics option to teachers.
2. That the Faculties of Education offer curriculum and instruction courses dealing specifically with mathematics option.
3. That the Department of Education, through its Regional offices, provide more in-service or professional development work to mathematics option teachers.
4. That mathematics option teachers in the same district begin to exchange ideas which ultimately result in planning sessions and workshops.
5. That mathematics option teachers improve their background in curriculum and instruction courses in mathematics.
6. That teachers offer to teach mathematics option only if they are capable of developing their own program.
7. That beginning teachers are not asked to teach mathematics option.

Recommendations Re: The Mathematics Option Student

It was observed that the findings about mathematics option students were inconsistent with the original intent of the program. In some cases, students required remedial help in mathematics and in others they had a negative attitude toward mathematics. Less than one-half of the students were in mathematics option out of interest in mathematics. This resulted in the following recommendations:

1. That the assignment of students to mathematics option be made on the basis of strength in mathematics.
2. That students, where possible, be given the freedom to choose mathematics, but that counselling be carried out at the same time.
3. That every attempt be made to group mathematics option students homogeneously with respect to mathematical ability.

Recommendations Re: The Nature of the Mathematics Option Curriculum

While many teachers offered a program consistent with the intents, some had seen a different purpose in mathematics option. Some felt it was meant for remedial instruction and others spent the time teaching core mathematics. It was also observed that student involvement differed considerably throughout the province. Students were not to be excluded from planning. But neither were they to be allowed to plan and conduct their activities without teacher guidance. Community resources were to play an important role in mathematics option but they were only rarely used. In light of the findings, the following recommendations were made:

1. That the mathematics option continues to be offered.
2. That the mathematics option remains unstructured with respect to Department of Education course outline. But that more assistance in terms of ideas and suggestions is provided to teachers.

3. That mathematics option neither be used for remedial instruction nor for teaching core mathematics.
4. That students be involved in planning learning activities.
5. That community resources be used maximally in mathematics option.
6. That every attempt is made to provide programs for the needs, interests, and abilities of students.

Recommendations Re: Materials and Facilities

Teachers were held responsible to assess the resources of the community before offering mathematics option. It was found that mathematics option was offered in schools which were inadequately prepared in terms of materials and facilities. This resulted in the following recommendations:

1. That schools with inadequate facilities and insufficient resources and materials do not offer mathematics option.
2. That schools in the same jurisdiction consider interchanging materials and resources.
3. That schools allocate part of their budget to mathematics option.
3. That more and new materials be developed in mathematics option for placement in a central "bank" and that communication devices be initiated to inform the teachers about these materials.

Recommendations Re: Instructional Activities

The nature of mathematics option lends itself to a wide variety of instructional activities. Emphasis was to be placed upon individualized instruction, library research, math-lab experiments, and field trips. It was found that paper-pencil activities in the form of worksheets were by far the major activity. The recommendations are, therefore, as follows:

1. That teachers be encouraged, through Local Authority or Regional Offices, to strive to achieve a broader repertoire of instructional activities in the classroom.
2. That teachers, whenever possible or applicable, use field trips and/or community resources more frequently.
3. That the emphasis be placed upon independent study and small group work in mathematics option classes.

Recommendations Re: Time Allotment

The guidelines with respect to time, was indicated in the Junior-Senior High School Handbook, were extremely flexible. Most teachers used between two and four forty minute periods per week for a full-year course.

A large number of teachers offered mathematics option as a full-year course. The second most frequent type of schedule was the semestered program. All other types of schedule were literally ignored. Based on these findings, the following recommendations seemed appropriate.

1. That no changes occur in the Department of Education guidelines regarding time allotment for B-options.
2. That, wherever possible, modular scheduling be used in mathematics option.

Recommendations Re: General Objectives of Mathematics Option

The objectives in each school differed over a wide range. Only one objective, the development of more positive attitudes toward mathematics, was considered important by nearly all teachers. Much emphasis was also placed on developing creative thinking in mathematics. This resulted in the following recommendation:

1. That teachers make deliberate attempts to develop mathematics option

programs in which the emphasis is placed on developing more positive attitudes toward and creative thinking in mathematics.

Recommendations Re: Effect of the Program on the Teacher

Five areas were examined that might have had a possible effect on the teacher. They dealt with the amount of supervision in mathematics option, student discipline, planning and preparation time for teachers, the amount of physical and mental strain on mathematics option teachers, and the enrollment in mathematics option classes. It was found that planning and preparation time for teachers and class enrollments were the two most crucial issues among teachers.

Hence the following recommendations:

1. That teachers teaching mathematics option receive adequate planning and preparation time.
2. That every attempt is being made to maintain small mathematics option classes and in particular that these classes do not exceed 25 students per class.

Concluding Thought

Much information has been presented in this thesis which will hopefully result in more effective and satisfying teaching practices throughout Alberta. Some of the findings were based upon fairly concise and quantifiable data. Others, however, were conclusions based on impressionistic evidence. While many areas were found to be deviating from the philosophy and concept of mathematics option, the potential for improvement and development, however, are great.

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APPENDIX A

Summary of Participating Schools And School Systems By Grade And Sample Size

SUMMARY OF PARTICIPATING SCHOOLS AND SCHOOL SYSTEMS BY GRADE AND SAMPLE SIZE

N = 417

SCHOOL	LOCATION	N	MATH. OPTION GROUP (GRADE)	N	NON-MATH. OPTION GROUP (GRADE)	TEACHERS MALE	TEACHERS FEMALE
SIR JOHN THOMPSON	EDMONTON SEPARATE SCHOOL DISTRICT #7	10	7	10	7	1	
		10	8	10	8		
ST. THOMAS MORE		10	8	10	8	1	
ST. KEVIN		10	8	10	8	1	
		10	9	10	9		
A. L. HORTON	COUNTY OF NINBURN #27	10	8	10	8	1	
MONTROSE JUNIOR HIGH SCHOOL	GRANDE PRAIRIE SCHOOL DISTRICT #2357	10	7	10	7		
		10	8	10	8		1
		10	9	10	9	1	
PIPESTONE SCHOOL	COUNTY OF WETASKIWIN #10	8	7	8	7	1	
		9	8	9	8		
REGIONAL JUNIOR HIGH SCHOOL	COUNTY OF GRANDE PRAIRIE #1	10	7	10	7		1
		10	8	10	8		1
		10	9	10	9	1	

SUMMARY OF PARTICIPATING SCHOOLS AND SCHOOL SYSTEMS BY GRADE AND SAMPLE SIZE (Continued)

SCHOOL	LOCATION	N	MATH OPTION GROUP (GRADE)	N	NON-MATH. OPTION GROUP (GRADE)	TEACHERS MALE	TEACHERS FEMALE
R. I. BAKER	COUNTY OF	10	7	10	7		
	LETHBRIDGE	10	8	10	8	1	
	#26	10	9	10	9		
ROCKY MOUNTAIN HOUSE	ROCKY MOUNTAIN	10	7	-	-		1
	SCHOOL DIVISION	10	8	-	-		1
	#15	9	9	-	-	1	
CRESCENT HEIGHTS	MEDICINE HAT	9	7	9	7		1
	SCHOOL DISTRICT	8	9	8	9	1	
	#76						
HARRY COLLINGE	YELLOWHEAD						
	SCHOOL DIVISION	10	9	10	9	1	
	#12						

APPENDIX B

Letter to Superintendents, Cover Letter for Teacher Questionnaire, Follow-up Letter to Teachers

Department of Secondary Education
University of Alberta
Edmonton, Alberta
24 April, 1974

Superintendent of Schools

Dear

I am currently working on a Master of Education thesis entitled "An Evaluation of the Mathematics B-option in Alberta". This project is approved and financially supported by the Department of Education.

This research project employs a number of instruments of which one is a questionnaire for mathematics B-option teachers.

Two hundred mathematics B-option teachers have been randomly selected and some of these teachers teach in your area.

I wish to seek your permission to approach these teachers in your area and ask them to fill in this questionnaire.

A response is not necessary in the case of your accepting my request. If, however, you object, please advise me by mail or phone me collect at 465 - 5184.

Thank you for your consideration.

Yours sincerely,

Klaus Puhlmann
Department of Secondary Education
University of Alberta

KP/sp

University of Alberta
Edmonton, Alberta
April, 1974

Dear Teacher:

The mathematics B-option was introduced in Alberta's junior high school curriculum in 1969. Since then schools across the province have offered this course with varying degrees of success. It is my opinion that after almost five years an evaluation should be carried out to ascertain some information on the significant aspects in mathematics B-option. This questionnaire is an attempt to obtain some information from you, the mathematics option teacher.

The Department of Education has shown considerable interest in this study and has given approval and financial assistance to conduct this study throughout the province.

Questionnaires are being mailed to 200 randomly-selected mathematics option teachers in Alberta. Your name was obtained from the 1973-74 Form A card that was submitted by your school to the Department of Education. In some cases 2 or 3 teachers have been selected from one school and it is hoped that all of you fill in this questionnaire.

Many of you may not teach mathematics option when you receive this questionnaire but it would be appreciated if you would fill in this questionnaire making reference to your latest mathematics option teaching experience. If you teach (or taught) more than one class in mathematics option, select only one for the purpose of answering this questionnaire.

This survey is anonymous and will not require your name. The design of this questionnaire has been chosen for your convenience. Except for the last section, all questions can be answered by simply placing a check mark (✓) before the appropriate answer.

There are nine sections to this questionnaire. Many questions are stated twice. One question asks you to indicate as it is now and the other question asks you to indicate how you think it should be.

After completing the questionnaire, simply return it in the enclosed self-addressed envelope as soon as possible.

If you wish a copy of the results, please write your name and address on the bottom of this letter and return it in the white self-addressed envelope.

Again, thank you very much for your participation.

Yours sincerely

Klaus Puhlmann
Department of Secondary Education
University of Alberta

KP/sp

NAME ____

ADDRESS ____

____

Department of Secondary Education
University of Alberta
Edmonton, Alberta
11 May, 1974

Dear Teacher:

In April, I sent you a questionnaire on the mathematics B-options in Alberta requesting that you complete and return the questionnaire. If you have already done so, I would like to take this opportunity to thank you for your participation. To date, the response to this questionnaire has been excellent. Hopefully the data collected will become a basis for future decisions in the mathematics B-option in Alberta.

If you have not yet had time to complete the survey may I ask you to take a few moments to complete it and return same in the self-addressed envelope. Remember, if you would like a copy of the results, please forward your name and address in the white self-addressed envelope.

Trusting that I shall hear from you soon.

Yours sincerely,

Klaus Puhlmann

Klaus Puhlmann
Department of Secondary Education
University of Alberta

KP/sp

APPENDIX C

Directions for the Teachers
for Test Administration
at TIME 1 and TIME 2

DIRECTIONS FOR THE TEACHER (TIME 1)

Enclosed find two sets of tests:
1. Attitude test (semantic differential)
2. Test of creative ability in mathematics.

Please administer both tests to each group during the month of February:

Group 1: (Experimental group)
Students in this group are enrolled in mathematics B-option. Please select, at random, 10 students from each of grades 7, 8 and 9 (total of 30 students) who comprise the experimental group.

Group 2: (Control group)
Students in this group are not taking mathematics B-option. Please select, at random, 10 students from each of grades 7, 8 and 9 (total of 30 students) who comprise the control group.

ADMINISTRATION OF TESTS

Attitude Test:

1. This test is to be administered first.
2. Familiarize yourself with the directions on the test. It is important that students understand the positions on the five-point scale.
3. Please make students aware that the concepts on top of the page differ but the scales for each concept remain the same. Some scales may not be useful in describing a concept but it is important that the students do not omit any of the scales.
4. Explain the neutral position on the scales (position 3).
5. Please point out to students that this test has no right or wrong answers.
6. This test has no time limit but students require approximately 15-20 minutes.
7. Encourage students to work rapidly but at the same time emphasize that it is important to give honest responses.
8. It is of utmost importance that the information on the first page is properly filled in. Notice that the student's name is not required on this test.

Test of Creative Ability in Mathematics:

1. Directions for administration are on a separate sheet.
2. Again, it is important that the personal information is properly filled in on the first page. This time the student is asked for his/her name.
3. Please point out that the result will not in any way effect the student's school record.

4. This test is timed with 5 minutes for each part.
5. Please explain only one part at a time and then have students do this part.

It is possible to administer both tests successively in one period.

Please fill in the student list and indicate the grade and to which group the students belong.

Please return the following:

1. The set of written attitude tests.
2. The set of written creativity tests.
3. The completed student list.

Return postage is enclosed in an envelope. An early return would be much appreciated, so that computer programming can commence. Should you have any questions please phone me collect at 465-5184 (after 5 p.m.) Good luck! Thank you.

Yours sincerely,

Klaus Puhlmann
Department of Secondary Education
University of Alberta.

KP/sp

DIRECTIONS FOR THE TEACHER (TIME 2)

Enclosed find the following:

1. Attitude tests (semantic differential)
2. Test of creative ability in mathematics (Post-test)
3. Questionnaires for students in mathematics option.

Please administer both tests and the questionnaire to the students on the list following the directions below. In order that the testing is carried out at approximately the same time in all schools would you please administer these tests during the week of May 27-31, 1974.

ADMINISTRATION OF TESTS

Attitude Test:

1. This test is to be administered first to all students listed on the student list.
2. Familiarize yourself with the directions on the test. It is important that students understand the positions on the five-point scale.
3. Please make students aware that the concepts on top of the page differ, but the scales for each concept remain the same. Some scales may not be useful in describing a concept but it is important that the students do not omit any of the scales.
4. Explain the neutral position on the scales (position 3)
5. Please point out to students that this test has no right or wrong answers.
6. This test has no time limit but students require approximately 15-20 minutes.
7. Encourage students to work rapidly but at the same time emphasize that it is important to give honest responses.
8. It is of utmost importance that the information on the first page is properly filled in. The student's name is not required on this test.

Test of Creative Ability in Mathematics:

1. Directions for administration are on a separate sheet.
2. Please administer to all students listed on student list.
3. Again, it is important that the personal information is properly filled in on the first page. This time the students are asked to fill in their names.
4. Please point out that the result will not in anyway effect the student's school record.
5. This test is timed with 5 minutes for each part.
6. Please explain only one part at a time and then have students do this part.

Questionnaire for students in Mathematics Option:

1. Please administer this questionnaire to the students on the student list who are enrolled in mathematics option (ie. Experimental group only)
2. Please discuss with the students the directions on the questionnaire.
3. This questionnaire is not timed but students require approximately 10-15 minutes.

Please return the following:

1. The set of written attitude tests
2. The set of written creativity tests.
3. The set of completed student questionnaires.

Return postage is enclosed in an envelope. An early return would be much appreciated, so that computer programming can commence. If you have any questions please phone me collect at 465 - 5184. Good luck! Thank you.

Yours sincerely,

Klaus Puhlmann
Department of Secondary Education
University of Alberta

KP/sp

APPENDIX D

Pilot Study Report for
Mathematics Option Teacher Questionnaire,
Mathematics Option Teacher Questionnaire

PILOT STUDY

Mathematics Option Teacher Questionnaire

Instrument Construction: This instrument was to serve as an information retrieval device with the focus on eight areas of concern. The eight areas covered by the instrument are: (1) Teacher Characteristics, (2) Student Characteristics, (3) Nature of the Mathematics Option Curriculum, (4) Instructional Materials and Facilities, (5) Instructional Activities, (6) Time Allocation, (7) General Objectives of the Mathematics Option Program, and (8) Effect of the Mathematics Option Program on the Teacher.

The decision to include these 8 areas was largely guided by the review of literature, the investigator's interest, and the directions provided by the Department of Education. Each of the 8 areas was covered by a series of multiple choice questions that attempted to get at specific aspects related to each area. An additional characteristic of this questionnaire was the stating of the questions twice. One question asked the respondent to report "What is" and the other question asked "What should be".

Administration: In order to increase the face and content validity of the instrument it was decided to administer it in the following manner. A preliminary draft of the instrument was distributed to four professors, three graduate students, and three mathematics option teachers in order to assess its accuracy, clarity, and relevance to its intended purpose. After incorporating suggested changes a second draft was prepared and distributed to two professors and three mathematics option teachers. Again, minor changes were undertaken which, after consultation with the investigator's adviser, resulted in the final draft.

SECTION A

1. Sex: Male ( ) Female ( )

2. Size of school in terms of school enrollment is. (Check one)

( ) a) less than 150 students
( ) b) between 150 and 250 students
( ) c) more than 250 students

3. The enrollment in my mathematics option class is. (If you teach more than one class in mathematics option, select only one for the purpose of this questionnaire). (Check one)

( ) a) under 15
( ) b) 15 - 20
( ) c) 21 - 25
( ) d) 26 - 30
( ) e) more than 30

4. The enrollment in mathematics option classes should be. (Check one)

( ) a) under 15
( ) b) 15 - 20
( ) c) 21 - 25
( ) d) 26 - 30
( ) e) more than 30

THE QUESTIONS IN THIS SECTION DEAL WITH YOUR EXPERIENCE AND PROFESSIONAL BACKGROUND. FOR THE MOST PART YOU WILL FIND TWO PARALLEL QUESTIONS, ONE ASKING "WHAT IS" AND THE OTHER "WHAT SHOULD BE". THE "WHAT SHOULD BE" QUESTIONS INVOLVE YOUR JUDGMENT AND IT IS YOUR BEST POSSIBLE JUDGMENT THAT SHOULD BE RENDERED.

5. How many years of teaching experience do you have at the Junior High School level (ie. grade 7, 8, 9)? (Do not include the present school year). (Check one)

( ) a) no experience
( ) b) 1 year
( ) c) 2 years
( ) d) 3 years
( ) e) more than 3 years

6. How many years of teaching experience do you have in the mathematics option? (Do not include the present school year). (Check one)

( ) a) no experience
( ) b) 1 year
( ) c) 2 years
( ) d) 3 years
( ) e) more than 3 years

7. How many years of mathematics teaching experience at the Junior High School level would you consider necessary before teaching the mathematics option? (Check one)

( ) a) no experience (beginning teacher)
( ) b) 1 year experience
( ) c) 2 years experience
( ) d) 3 years experience
( ) e) more than 3 years

8. The number of university mathematics courses I have taken is. (Include Statistics and Computing Science) (Check one)

( ) a) none
( ) b) 1 - 3 course(s)
( ) c) 4 - 6 courses
( ) d) 7 - 9 courses
( ) e) more than 9

9. What would you consider a minimum number of university mathematics courses in order to teach the mathematics option? (Check one)

( ) a) none
( ) b) 1 - 3 course(s)
( ) c) 4 - 6 courses
( ) d) 7 - 9 courses
( ) e) more than 9

10. The number of curriculum and instruction (Methods) courses in mathematics that you have taken is. (Check one)

( ) a) none
( ) b) ½ - 1 course
( ) c) 1½ - 2 courses
( ) d) 2½ - 3 courses
( ) e) more than 3 courses

11. How many curriculum and instruction (methods) courses in mathematics would you consider necessary for mathematics option teacher? (Check one)

( ) a) none
( ) b) ½ - 1 course
( ) c) 1½ - 2 courses
( ) d) 2½ - 3 courses
( ) e) more than 3 courses

12. The decision for you to teach mathematics option was made. (Check one)

( ) a) on the basis of training in mathematics
( ) b) on volunteer basis
( ) c) on the basis of teaching experience at junior high school level
( ) d) by the school staff
( ) e) by the principal
( ) f)other: explain ___________

13. The decision for teachers to teach mathematics option should be made. (Check one)

( ) a) on the basis of training in mathematics
( ) b) on volunteer basis
( ) c) on the basis of teaching experience at junior high school level
( ) d) by the school staff
( ) e) by the principal
( ) f) other: explain ______________________________

14. In your opinion, how well are you prepared to teach mathematics option? (Check one)

( ) a) extremely well
( ) b) very well
( ) c) adequately
( ) d) poorly
( ) e) very poorly

15. Do you think that you are the best qualified teacher on your staff to teach the mathematics option?

Yes ( ) No ( )

SECTION B

THE QUESTIONS IN THIS SECTION DEAL WITH THE MATHEMATICS OPTION STUDENT. AGAIN, THE "WHAT IS" AND "WHAT SHOULD BE" FORMAT IS BEING USED. IN ANSWERING THESE QUESTIONS CONSIDER THE GENERAL PRACTICE RATHER THAN SPECIFIC CASES.

1. The students in mathematics option are enrolled in the option courses as a result of: (Consider the general practice at your school) (Check one)

( ) a) personal choice
( ) b) the teacher's decision
( ) c) the administration's (eg. Principal, Counsellor) decision
( ) d) the parent's decision
( ) e) the course being compulsory
( ) f) other: explain ______________________________

2. Enrolling in mathematics option should be: (Consider the general practice at your school) Check one)

( ) a) the student's personal choice
( ) b) the teacher's decision
( ) c) the administration's (eg. Principal, Counsellor) decision
( ) d) the parent's decision
( ) e) compulsory
( ) f) other: explain ______________________________

3. Grouping of students in the mathematics option is. (Check one)

( ) a) homogeneous with respect to mathematical ability
( ) b) heterogeneous with respect to mathematical ability

4. Grouping of students in the mathematics option should be: (Check one)

( ) a) homogeneous with respect to mathematical ability
( ) b) heterogeneous with respect to mathematical ability

5. The students enrolled in the mathematics option course are generally: (Check one)

( ) a) students requiring remedial help in mathematics
( ) b) students with high mathematical ability
( ) c) students with positive attitudes toward mathematics
( ) d) other: explain ____________________

6. The students enrolled in mathematics option should be students: (Check one)

( ) a) requiring remedial help in mathematics
( ) b) with high mathematical ability
( ) c) with positive attitudes toward mathematics
( ) d) other: explain ____________________

7. Students enrolled in mathematics option differ from those that are not enrolled in that: (Check one)

( ) a) the former have better attitudes toward mathematics
( ) b) the former have greater ability in mathematics
( ) c) the former are more creative in mathematics
( ) d) there is no difference between these two groups in mathematical ability and/or attitudes
( ) e) other: explain ____________________

____

8. Students enrolled in mathematics option compared to those that are not enrolled should: (Check one)

( ) a) have better attitudes toward mathematics
( ) b) have greater ability in mathematics
( ) c) be more creative in mathematics
( ) d) not be different in mathematical ability and/or attitudes from those students that are not enrolled
( ) e) other: explain ____________________

____

9. The mathematics option should be taught in: (Check one)

( ) a) grade 7 only
( ) b) grade 8 only
( ) c) grade 9 only
( ) d) grade 8 and 9 only
( ) e) grade 7, 8 and 9
( ) f) other: explain ____________________

SECTION C

THIS SECTION DEALS WITH VARIOUS ASPECTS OF THE MATHEMATICS OPTION CURRICULUM. TRY TO ASSESS THE SITUATIONS IN YOUR CLASSROOM BY ANSWERING THE "WHAT IS" QUESTIONS. THE ANSWERS TO THE "WHAT SHOULD BE" QUESTIONS SHOULD AGAIN BE A REFLECTION OF YOUR BEST POSSIBLE JUDGMENT.

1. Your present program in the mathematics option is primarily. (Check one)

( ) a) a remedial course for students with problems in regular mathematics
( ) b) an enrichment course
( ) c) a general interest course
( ) d) providing for individual interests and abilities
( ) e) other: explain ______________________________

____

2. The program in the mathematics option should be primarily. (Check one)

( ) a) a remedial course for students with problems in regular mathematics
( ) b) an enrichment course
( ) c) a general interest course
( ) d) providing for individual interests and abilities
( ) e) Other: explain ______________________________

____

3. To what extent do students contribute to the selection of curricular content in the mathematics option? (Check one)

( ) a) to a great extent
( ) b) to some extent
( ) c) to a very little extent
( ) d) not at all

4. To what extent should students contribute to the selection of curricular content in the mathematics option? (Check one)

( ) a) to a great extent
( ) b) to some extent
( ) c) to a very little extent
( ) d) not at all

5. How are students helping you to structure the mathematics option program? (Check one)

( ) a) by way of suggesting activities which are then used to organize a program for the whole class
( ) b) each student submits suggestions which are then used to plan an individual program for that student
( ) c) students select activities from a pool of suggestions submitted by the teacher
( ) d) the limited background does not permit the students to help
( ) e) other: explain ______________________________

____

6. How should students help you to structure the mathematics option program? (Check one)

   - ☐ a) by way of suggesting activities which are then used to organize a program for the whole class
   - ☐ b) each student submits suggestions which are then used to plan an individual program for that student
   - ☐ c) students select activities from a pool of suggestion submitted by the teacher
   - ☐ d) the limited background does not permit the students to help
   - ☐ e) other: explain ______________________________

     ____

7. The overlap of the content of the mathematics option curriculum with the regular mathematics program is: (Check one)

   - ☐ a) very substantial
   - ☐ b) substantial
   - ☐ c) moderate
   - ☐ d) as little as possible

8. The overlap of the content of the mathematics option curriculum with the regular mathematics program should be: (Check one)

   - ☐ a) very substantial
   - ☐ b) substantial
   - ☐ c) moderate
   - ☐ d) as little as possible

9. To what extent do you use the resources of the community and environment to demonstrate possible applications of mathematics? (Check one)

   - ☐ a) most of the time
   - ☐ b) frequently
   - ☐ c) sometimes
   - ☐ d) seldom
   - ☐ e) never

10. To what extent should one use the resources of the community and environment to demonstrate possible applications of mathematics? (Check one)

    - ☐ a) most of the time
    - ☐ b) frequently
    - ☐ c) sometimes
    - ☐ d) seldom
    - ☐ e) never

11. In my mathematics option program I am able to provide for the needs, interests and abilities of. (Check one)

( ) a) all students
( ) b) most students
( ) c) some students
( ) d) very few students

12. I find the development of a curriculum for the mathematics option to be. (Check one)

( ) a) a very easy task
( ) b) no more difficult than planning for other subjects
( ) c) more difficult than other subjects
( ) d) a very difficult task
( ) e) beyond my ability

13. To what extent should the mathematics B-option be structured? (Check one)

( ) a) completely structured by the Department of Education as for example the regular mathematics

( ) b) about one half structured and the other half developed by the teacher

( ) c) unstructured, but with more assistance in terms of suggestions and ideas from the Department of Education

( ) d) completely unstructured as it exists now

( ) e) because of the way it is operating, the option should be dropped

SECTION D

IN THIS SECTION YOU ARE ASKED TO PASS JUDGMENT ON THE AVAILABILITY OF MATERIALS AND FACILITIES FOR MATHEMATICS OPTION IN YOUR SCHOOL

Please rate each item according to what you think is the situation at your school.

Ratings to be Used

1 = not desirable to have
2 = not applicable (non-existent)
3 = poor, should be improved
4 = fair, needs attention
5 = good, satisfactory
6 = very good, highly effective

	Check appropriate space					
	1	2	3	4	5	6
1. Mathematics laboratory						
2. Storage facilities for supplies and equipment						
3. Library						
4. Journals in Mathematics and Science						
5. Mathematics reference books (other than textbooks)						
6. Individual learning packages (UNIPAKS)						
7. Teacher-prepared materials, such as project outlines, guides, etc.						
8. Mathematical games and puzzles						
9. Visual aids such as graphs, diagrams, charts and models						
10. Mathematics films and video-tapes						
11. Filmstrips and slides in mathematics						
12. Material and supplies for projects (eg. construction paper and other types, glue, wood, etc.)						
13. Mathematical instruments such as slide rules, protractors, parallel rules, compasses, calculating machines, etc.						
14.						

SECTION E

THIS SECTION FOCUSES ON INSTRUCTIONAL ACTIVITIES

In carrying out your mathematics option program, to what extent are the following modes of instruction used. Under "At present" rate as it is now, and under "Should be" indicate the extent to which you think these modes should be used in the mathematics option. Indicate on both sides by encircling the appropriate number. Add more to this list if you feel your approach is not included.

Ratings to be Used

1 = never
2 = seldom
3 = moderately
4 = frequently
5 = often

AT PRESENT		SHOULD BE
never 1 2 3 4 5 often	1. Teacher lecture	never 1 2 3 4 5 often
1 2 3 4 5	2. Teacher demonstration	1 2 3 4 5
1 2 3 4 5	3. Class discussions	1 2 3 4 5
1 2 3 4 5	4. Small group discussion	1 2 3 4 5
1 2 3 4 5	5. Individual projects	1 2 3 4 5
1 2 3 4 5	6. Library research	1 2 3 4 5
1 2 3 4 5	7. Math-lab experiments	1 2 3 4 5
1 2 3 4 5	8. Paper-pencil activities	1 2 3 4 5
1 2 3 4 5	9. Field trips and excursions	1 2 3 4 5
1 2 3 4 5	10. Drill practice	1 2 3 4 5
1 2 3 4 5	11. Student directed class discussions	1 2 3 4 5
1 2 3 4 5	12. Resource persons from community	1 2 3 4 5
1 2 3 4 5	13. Films, slides and filmstrips	1 2 3 4 5
1 2 3 4 5	14. Small group projects	1 2 3 4 5
1 2 3 4 5	15. Class projects	1 2 3 4 5
1 2 3 4 5	16. Mathematical game approach	1 2 3 4 5
1 2 3 4 5	17. Individual teacher/student conferences	1 2 3 4 5
1 2 3 4 5	18. Individual learning packages (UNIPAKS)	1 2 3 4 5
1 2 3 4 5	19.	1 2 3 4 5
1 2 3 4 5	20.	1 2 3 4 5
1 2 3 4 5	21.	1 2 3 4 5

SECTION F

THE QUESTIONS IN THIS SECTION FOCUS ON TIME ALLOCATION AND THE LENGTH OF THE PROGRAM OFFERING.

1. The total time of instruction for my mathematics option class is approximately: (Select the answer that is closest to your situation) (Check one)

( ) a) two 40 minute periods per week
( ) b) three 40 minute periods per week
( ) c) four 40 minute periods per week
( ) d) five 40 minute periods per week
( ) e) other: explain ______________________________

____

2. The present time allotment per week for my mathematics option class is: (Check one)

( ) a) too much
( ) b) sufficient
( ) c) not enough

3. The mathematics option program at our school at the present time is: (Check one)

( ) a) a full year course
( ) b) semestered
( ) c) trimestered
( ) d) other: explain ______________________________

____

4. The mathematics option program should be offered as: (Check one)

( ) a) a full year course
( ) b) semestered course
( ) c) trimestered course
( ) d) other: explain ______________________________

____

SECTION G

THIS SECTION FOCUSES ON SOME GENERAL OBJECTIVES FOR THE MATHEMATICS OPTION

Please rate each of the following according to their importance in your mathematics option program by encircling the appropriate number. You are asked to add objectives if you think they have been omitted.

Ratings to be Used

1 - very unimportant
2 - unimportant
3 - mediocre
4 - important
5 - very important

1. To increase the students level of achievement in regular mathematics — Very Unimportant 1 2 3 4 5 Very Important

2. To develop more positive attitudes toward mathematics — 1 2 3 4 5

3. To develop the students' confidence in their ability — 1 2 3 4 5

4. To develop creative thinking in mathematics — 1 2 3 4 5

5. To develop a sense of responsibility — 1 2 3 4 5

6. To acquaint students with the contributions of mathematics to the progress of civilization — 1 2 3 4 5

7. To develop basic mathematical skill — 1 2 3 4 5

8. To develop precision in thought and expression — 1 2 3 4 5

9. To acquaint students with the logical structure of mathematics — 1 2 3 4 5

10. To develop speed and efficiency in mathematical computations — 1 2 3 4 5

11. To develop the students' ability to think critically — 1 2 3 4 5

12. To develop skills in the retrieval and use of mathematical information — 1 2 3 4 5

13. To develop the students' ability in logical thinking — 1 2 3 4 5

14. To provide students with time for free exploration in mathematics — 1 2 3 4 5

15. To allow the student to study in depth a topic in mathematics of his choice — 1 2 3 4 5

16. To allow the student time to study relevant application of mathematics — 1 2 3 4 5

SECTION H

THE QUESTIONS IN THIS SECTION ATTEMPT TO ASCERTAIN THE EFFECT OF THE MATHEMATICS OPTION PROGRAM ON YOU, THE TEACHER.

1. Students work well with little supervision in the mathematics option. (Check one)

   ( ) a) strongly agree
   ( ) b) agree
   ( ) c) neutral
   ( ) d) disagree
   ( ) e) strongly disagree

2. In general, there are more discipline problems in the mathematics option than in core subjects. (Check one)

   ( ) a) strongly agree
   ( ) b) agree
   ( ) c) neutral
   ( ) d) disagree
   ( ) e) strongly disagree

3. Lesson preparation and planning in the mathematics option require more time than in any other subject. (Check one)

   ( ) a) strongly agree
   ( ) b) agree
   ( ) c) neutral
   ( ) d) disagree
   ( ) e) strongly disagree

4. In general, there is greater mental and physical strain on teachers teaching mathematics option than on teachers teaching core subjects. (Check one)

   ( ) a) strongly agree
   ( ) b) agree
   ( ) c) neutral
   ( ) d) disagree
   ( ) e) strongly disagree

5. In general, how satisfied are you with teaching the mathematics option? (Check one)

   ( ) a) very satisfied
   ( ) b) generally satisfied
   ( ) c) undecided
   ( ) d) somewhat dissatisfied
   ( ) e) very dissatisfied

SECTION I

IN THIS SECTION OF THE QUESTIONNAIRE YOU ARE ASKED TO SHARE YOUR IDEAS, SUGGESTIONS AND EXPERIENCES IN THE MATHEMATICS OPTION.

Please describe any topic or activity that was successful for you in mathematics option. Your suggestions can also include such things as books, games or any other resources that you feel are useful in the mathematics option.

(The format below does not need to be followed and you are not restricted in the number of suggestions you wish to add).

Topic: ______________________________

____

____

Author:
(if applicable: ______________________________

Grade suitable: ______________________________

Objective: ______________________________

____

____

APPENDIX E

Pilot Study Report for
Semantic Differential Attitude Test,
Semantic Differential Attitude Test

PILOT STUDY

Semantic Differential Attitude Test

Instrument Construction: The semantic differential for this study had been developed using the "arm chair" approach. This approach implies that the selection of scales and concepts can be determined by research of literature rather than by sampling analysis of the subjects.

Concepts: The semantic differential was to be used to measure attitudes toward mathematics and other related concepts. The selection of concepts was guided by a number of considerations.

1. That the number of concepts should provide best coverage of the conceptual area.
2. That the concepts are multifaceted, capable of evoking a variety of associations both within and among subjects.
3. That the concepts be familiar to Grade 7, 8, and 9 students.
4. That the concepts have a single unitary meaning for the individual.
5. That subjects can complete the semantic differential in the time provided.

The list that was arrived at, through literature, discussions with graduate students and professors consisted of 9 concepts. They are: (1) Mathematics, (2) My Math Teacher Is, (3) Myself, (4) Taking A Math Test Is, (5) My School, (6) My Math Class Is, (7) My Classmates Are, (8) My Math Textbook Is, and (9) Math Homework Is.

Scales: The scales were selected by the investigator keeping Osgood's (1957) suggestion in mind that scales for a semantic differential should be selected in a way that would make them relevant to the situation which is to be evaluated. The main source for scale selection was provided by the research literature in the field of mathematics. Maguire's (1973) guidelines for scale selection were closely followed.

1. The scales had to be representative of the attitude in the domain.
2. The scales had to be well defined for the population of interest.
3. The scales had to be appropriate to the previously selected concepts in the domain.
4. The scales had to be polar opposites.
5. The scales had to be clear to the subjects.

Again, the amount of time available for administration constituted an additional constraint.

Administration of instrument: This instrument was administered on January 18, 1974 and again on March 8, 1974 to a sample of 20 students at J. H. Picard High School in Edmonton. Ten students were randomly selected from each of grade 7 and grade 9. The grade 7 group included 5 boys and 5 girls and the grade 9 group included 4 boys and 6 girls.

Aside from the responses that were given, the investigator also wanted to know how clear and suitable the concepts and scales were. This was done by asking the subjects the following questions.

1. Write down any concept that was not clear to you.
2. Write down any scale that was not clear to you.
3. Do you think that the concepts selected may have an influence on one's attitude toward mathematics?

Of the twenty students none had difficulty understanding the scales and concepts. There was unanimous agreement on question 3. This survey is not trying to suggest that, had sampling analysis of the subjects been used, the subjects would have selected the same concepts and scales. This was merely done to give the investigator the assurance that the scales and concepts that were selected were clear to the subjects.

Anyone interested in more detailed information regarding the pilot study is invited to contact the investigator.

SEMANTIC DIFFERENTIAL ATTITUDE TEST

GRADE: 7 ______ 8 ______ 9 ______

BOY: ______ GIRL: ______

NAME OF SCHOOL: ______________________________

DATE: ______________________

ENROLLED IN MATHEMATICS OPTION: YES ____ NO ____

DIRECTIONS

The purpose of this test is to get your reactions to certain concepts by having you rate each concept using a series of descriptive scales. On each page of this booklet you will find a different concept to be judged and beneath it a set of scales. You are to rate the concept on each page using these scales in order.

Here is how you are to use these scales: If you feel that the concept at the top of this page is very closely related to one end of the scale, you should place your check-mark as follows:

fair _x_:___:___:___:___ unfair

or

fair ___:___:___:___:_x_ unfair

If you feel that the concept is quite closely related to one or the other end of the scale (but not extremely) you should place your check-mark as follows:

strong ___:_x_:___:___:___: weak

or

strong ___:___:___:_x_:___ weak

If you consider the concept to be neutral, completely irrelevant to a particular scale or unrelated, then check the number 3 as follows:

heavy ___:___:_x_:___:___ light

Please:

1. You may circle any number, 1 through 5.
2. Check clearly one number on each scale for every concept.
3. Do not omit any scale or concept.
4. Make the judgment on the basis of what these concepts mean to you.
5. Work as rapidly as possible. Do not look back in your test. We want careful, but immediate, first impressions.

MATHEMATICS

1. valuable 1 : 2 : 3 : 4 : 5 worthless
2. weak 1 : 2 : 3 : 4 : 5 strong
3. good 1 : 2 : 3 : 4 : 5 bad
4. unfair 1 : 2 : 3 : 4 : 5 fair
5. foolish 1 : 2 : 3 : 4 : 5 wise
6. relaxed 1 : 2 : 3 : 4 : 5 worried
7. unpleasant 1 : 2 : 3 : 4 : 5 pleasant
8. easy 1 : 2 : 3 : 4 : 5 difficult
9. dirty 1 : 2 : 3 : 4 : 5 clean
10. nice 1 : 2 : 3 : 4 : 5 awful
11. dark 1 : 2 : 3 : 4 : 5 bright
12. happy 1 : 2 : 3 : 4 : 5 sad
13. dull 1 : 2 : 3 : 4 : 5 alive
14. active 1 : 2 : 3 : 4 : 5 passive
15. dishonest 1 : 2 : 3 : 4 : 5 honest
16. interesting 1 : 2 : 3 : 4 : 5 boring
17. meaningful 1 : 2 : 3 : 4 : 5 meaningless
18. unimportant 1 : 2 : 3 : 4 : 5 important

MY MATH TEACHER IS

19. valuable 1 : 2 : 3 : 4 : 5 worthless
20. weak 1 : 2 : 3 : 4 : 5 strong
21. good 1 : 2 : 3 : 4 : 5 bad
22. unfair 1 : 2 : 3 : 4 : 5 fair
23. foolish 1 : 2 : 3 : 4 : 5 wise
24. relaxed 1 : 2 : 3 : 4 : 5 worried
25. unpleasant 1 : 2 : 3 : 4 : 5 pleasant
26. easy 1 : 2 : 3 : 4 : 5 difficult
27. dirty 1 : 2 : 3 : 4 : 5 clean
28. nice 1 : 2 : 3 : 4 : 5 awful
29. dark 1 : 2 : 3 : 4 : 5 bright
30. happy 1 : 2 : 3 : 4 : 5 sad
31. dull 1 : 2 : 3 : 4 : 5 alive
32. active 1 : 2 : 3 : 4 : 5 passive
33. dishonest 1 : 2 : 3 : 4 : 5 honest
34. interesting 1 : 2 : 3 : 4 : 5 boring
35. meaningful 1 : 2 : 3 : 4 : 5 meaningless
36. unimportant 1 : 2 : 3 : 4 : 5 important

MYSELF

37. valuable _1_ : _2_ : _3_ : _4_ : _5_ worthless

38. weak _1_ : _2_ : _3_ : _4_ : _5_ strong

39. good _1_ : _2_ : _3_ : _4_ : _5_ bad

40. unfair _1_ : _2_ : _3_ : _4_ : _5_ fair

41. foolish _1_ : _2_ : _3_ : _4_ : _5_ wise

42. relaxed _1_ : _2_ : _3_ : _4_ : _5_ worried

43. unpleasant _1_ : _2_ : _3_ : _4_ : _5_ pleasant

44. easy _1_ : _2_ : _3_ : _4_ : _5_ difficult

45. dirty _1_ : _2_ : _3_ : _4_ : _5_ clean

46. nice _1_ : _2_ : _3_ : _4_ : _5_ awful

47. dark _1_ : _2_ : _3_ : _4_ : _5_ bright

48. happy _1_ : _2_ : _3_ : _4_ : _5_ sad

49. dull _1_ : _2_ : _3_ : _4_ : _5_ alive

50. active _1_ : _2_ : _3_ : _4_ : _5_ passive

51. dishonest _1_ : _2_ : _3_ : _4_ : _5_ honest

52. interesting _1_ : _2_ : _3_ : _4_ : _5_ boring

53. meaningful _1_ : _2_ : _3_ : _4_ : _5_ meaningless

54. unimportant _1_ : _2_ : _3_ : _4_ : _5_ important

TAKING A MATH TEST IS

55. valuable 1 : 2 : 3 : 4 : 5 worthless

56. weak 1 : 2 : 3 : 4 : 5 strong

57. good 1 : 2 : 3 : 4 : 5 bad

58. unfair 1 : 2 : 3 : 4 : 5 fair

59. foolish 1 : 2 : 3 : 4 : 5 wise

60. relaxed 1 : 2 : 3 : 4 : 5 worried

61. unpleasant 1 : 2 : 3 : 4 : 5 pleasant

62. easy 1 : 2 : 3 : 4 : 5 difficult

63. dirty 1 : 2 : 3 : 4 : 5 clean

64. nice 1 : 2 : 3 : 4 : 5 awful

65. dark 1 : 2 : 3 : 4 : 5 bright

66. happy 1 : 2 : 3 : 4 : 5 sad

67. dull 1 : 2 : 3 : 4 : 5 alive

68. active 1 : 2 : 3 : 4 : 5 passive

69. dishonest 1 : 2 : 3 : 4 : 5 honest

70. interesting 1 : 2 : 3 : 4 : 5 boring

71. meaningful 1 : 2 : 3 : 4 : 5 meaningless

72. unimportant 1 : 2 : 3 : 4 : 5 important

MY SCHOOL

73. valuable 1 : 2 : 3 : 4 : 5 worthless

74. weak 1 : 2 : 3 : 4 : 5 strong

75. good 1 : 2 : 3 : 4 : 5 bad

76. unfair 1 : 2 : 3 : 4 : 5 fair

77. foolish 1 : 2 : 3 : 4 : 5 wise

78. relaxed 1 : 2 : 3 : 4 : 5 worried

79. unpleasant 1 : 2 : 3 : 4 : 5 pleasant

80. easy 1 : 2 : 3 : 4 : 5 difficult

81. dirty 1 : 2 : 3 : 4 : 5 clean

82. nice 1 : 2 : 3 : 4 : 5 awful

83. dark 1 : 2 : 3 : 4 : 5 bright

84. happy 1 : 2 : 3 : 4 : 5 sad

85. dull 1 : 2 : 3 : 4 : 5 alive

86. active 1 : 2 : 3 : 4 : 5 passive

87. dishonest 1 : 2 : 3 : 4 : 5 honest

88. interesting 1 : 2 : 3 : 4 : 5 boring

89. meaningful 1 : 2 : 3 : 4 : 5 meaningless

90. unimportant 1 : 2 : 3 : 4 : 5 important

MY MATH CLASS IS

91. valuable 1 : 2 : 3 : 4 : 5 worthless
92. weak 1 : 2 : 3 : 4 : 5 strong
93. good 1 : 2 : 3 : 4 : 5 bad
94. unfair 1 : 2 : 3 : 4 : 5 fair
95. foolish 1 : 2 : 3 : 4 : 5 wise
96. relaxed 1 : 2 : 3 : 4 : 5 worried
97. unpleasant 1 : 2 : 3 : 4 : 5 pleasant
98. easy 1 : 2 : 3 : 4 : 5 difficult
99. dirty 1 : 2 : 3 : 4 : 5 clean
100. nice 1 : 2 : 3 : 4 : 5 awful
101. dark 1 : 2 : 3 : 4 : 5 bright
102. happy 1 : 2 : 3 : 4 : 5 sad
103. dull 1 : 2 : 3 : 4 : 5 alive
104. active 1 : 2 : 3 : 4 : 5 passive
105. dishonest 1 : 2 : 3 : 4 : 5 honest
106. interesting 1 : 2 : 3 : 4 : 5 boring
107. meaningful 1 : 2 : 3 : 4 : 5 meaningless
108. unimportant 1 : 2 : 3 : 4 : 5 important

MY CLASSMATES ARE

109. valuable 1 : 2 : 3 : 4 : 5 worthless

110. weak 1 : 2 : 3 : 4 : 5 strong

111. good 1 : 2 : 3 : 4 : 5 bad

112. unfair 1 : 2 : 3 : 4 : 5 fair

113. foolish 1 : 2 : 3 : 4 : 5 wise

114. relaxed 1 : 2 : 3 : 4 : 5 worried

115. unpleasant 1 : 2 : 3 : 4 : 5 pleasant

116. easy 1 : 2 : 3 : 4 : 5 difficult

117. dirty 1 : 2 : 3 : 4 : 5 clean

118. nice 1 : 2 : 3 : 4 : 5 awful

119. dark 1 : 2 : 3 : 4 : 5 bright

120. happy 1 : 2 : 3 : 4 : 5 sad

121. dull 1 : 2 : 3 : 4 : 5 alive

122. active 1 : 2 : 3 : 4 : 5 passive

123. dishonest 1 : 2 : 3 : 4 : 5 honest

124. interesting 1 : 2 : 3 : 4 : 5 boring

125. meaningful 1 : 2 : 3 : 4 : 5 meaningless

126. unimportant 1 : 2 : 3 : 4 : 5 important

MY MATH TEXTBOOK IS

127. valuable 1 : 2 : 3 : 4 : 5 worthless

128. weak 1 : 2 : 3 : 4 : 5 strong

129. good 1 : 2 : 3 : 4 : 5 bad

130. unfair 1 : 2 : 3 : 4 : 5 fair

131. foolish 1 : 2 : 3 : 4 : 5 wise

132. relaxed 1 : 2 : 3 : 4 : 5 worried

133. unpleasant 1 : 2 : 3 : 4 : 5 pleasant

134. easy 1 : 2 : 3 : 4 : 5 difficult

135. dirty 1 : 2 : 3 : 4 : 5 clean

136. nice 1 : 2 : 3 : 4 : 5 awful

137. dark 1 : 2 : 3 : 4 : 5 bright

138. happy 1 : 2 : 3 : 4 : 5 sad

139. dull 1 : 2 : 3 : 4 : 5 alive

140. active 1 : 2 : 3 : 4 : 5 passive

141. dishonest 1 : 2 : 3 : 4 : 5 honest

142. interesting 1 : 2 : 3 : 4 : 5 boring

143. meaningful 1 : 2 : 3 : 4 : 5 meaningless

144. unimportant 1 : 2 : 3 : 4 : 5 important

MATH HOMEWORK IS

145. valuable 1 : 2 : 3 : 4 : 5 worthless

146. weak 1 : 2 : 3 : 4 : 5 strong

147. good 1 : 2 : 3 : 4 : 5 bad

148. unfair 1 : 2 : 3 : 4 : 5 fair

149. foolish 1 : 2 : 3 : 4 : 5 wise

150. relaxed 1 : 2 : 3 : 4 : 5 worried

151. unpleasant 1 : 2 : 3 : 4 : 5 pleasant

152. easy 1 : 2 : 3 : 4 : 5 difficult

153. dirty 1 : 2 : 3 : 4 : 5 clean

154. nice 1 : 2 : 3 : 4 : 5 awful

155. dark 1 : 2 : 3 : 4 : 5 bright

156. happy 1 : 2 : 3 : 4 : 5 sad

157. dull 1 : 2 : 3 : 4 : 5 alive

158. active 1 : 2 : 3 : 4 : 5 passive

159. dishonest 1 : 2 : 3 : 4 : 5 honest

160. interesting 1 : 2 : 3 : 4 : 5 boring

161. meaningful 1 : 2 : 3 : 4 : 5 meaningless

162. unimportant 1 : 2 : 3 : 4 : 5 important

APPENDIX F

Pilot Study Report for
Mathematics Option Student Questionnaire,
Questionnaire for Students in Mathematics Option

PILOT STUDY

Mathematics Option Student Questionnaire

Instrument Construction: This instrument was used to retrieve information from mathematics option students in grades seven, eight, and nine. Most questions dealt with the students' perception of mathematics option. The items were written in multiple choice format.

Administration: In order to increase the face validity of the instrument it was decided to pilot it in the following manner. A preliminary draft of the instrument was then distributed to four professors, three graduate students, and three mathematics option teachers. The emphasis was placed on assessing the clarity and readability of the items. This assessment resulted in a number of changes with regard to wording. A second draft of this instrument was then administered to 5 grade seven mathematics option students who were judged by the principal as having reading problems. The administration of this instrument was carried out by the principal and he reported later that none of the students had difficulties. He also quoted the students as having said that this instrument makes "sense" and he felt the students were rather enthusiastic.

QUESTIONNAIRE FOR STUDENTS
IN
MATHEMATICS OPTION

DIRECTIONS

1. Do not omit any questions.
2. Answer all questions by simply placing a check-mark between the parentheses. Example: (✓)
3. Please check off one letter under each question only.
4. Please check off the answer that you think is best.
5. There is no right or wrong answer to these questions.

1. GRADE: 7 ( ) 8 ( ) 9 ( )

2. SCHOOL: ______________________ 3. SEX: Boy ( ) Girl ( )

4. Have you taken a mathematics option before? YES ( ) NO ( )

5. Taking the mathematics option was my own free choice. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

6. I chose this mathematics option because: (Check one)

( ) a) of my interest in mathematics
( ) b) I like my teacher
( ) c) my friends also take the option
( ) d) of timetable conflict
( ) e) the teacher advised me to
( ) f) other: explain ______________________

7. In mathematics option I am allowed to work in any area that is of interest to me. (Check one)

( ) a) all of the time
( ) b) much of the time
( ) c) sometimes
( ) d) very little of the time
( ) e) never

8. I seem to learn more about mathematics in the option course than I do in the regular mathematics. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

9. We have always enough materials and facilities for projects in mathematics option. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

10. In the mathematics option I work mostly. (Check one)

( ) a) by myself
( ) b) in small groups (2 or 3)
( ) c) as part of the whole class
( ) d) other: ____

11. If I could, I would take mathematics option again next year. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

12. In mathematics option we are marked. (Check one)

( ) a) on the same basis as in regular mathematics
( ) b) on a different basis from regular mathematics
( ) c) we are not marked in mathematics option

If different describe how you are marked.

____

____

____

13. My teacher's method of marking or grading is fair. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

14. I feel we have enough time per week in the mathematics option program. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

15. What we are trying to do in mathematics option seems clear to me. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

16. Mathematics option includes topics that are taken in the regular mathematics program. (Check one)

( ) a) all of the time
( ) b) much of the time
( ) c) sometimes
( ) d) very little of the time
( ) e) never

17. I feel mathematics option should continue to be offered the way it is. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

18. I feel that other courses should be organized in the same way as the mathematics option. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

19. I like my mathematics option class. (Check one)

( ) a) strongly agree
( ) b) agree
( ) c) undecided
( ) d) disagree
( ) e) strongly disagree

APPENDIX G

Directions for Administering
Creativity Test at TIME 1,
Creativity Test TIME 1,
Directions for Administering
Creativity Test at TIME 2,
Creativity Test TIME 2,
Summary of Test Norms.

TEST OF CREATIVE ABILITY IN MATHEMATICS

DIRECTIONS FOR THE TEACHER (TIME 1)

1. This booklet should remain closed until you tell the students to proceed to Part 1.
2. Make sure that the personal information is filled in by all participants.
3. Use the sample item to explain the nature of this test.
4. As you proceed to Part 1, be certain that everyone understands question A and B of this part. Then time a five minute period for the students to work on Part 1 (questions A and B).
5. Repeat the procedure under 4 for Part 2 and Part 3. Note that each part takes five minutes.
6. Before starting Part 3, draw a square, rectangle, parallelogram, rhombus and an equilateral triangle on the blackboard and label them, so that students do not waste time trying to think what these figures are.
7. Encourage the students to work as fast as they can in each part.
8. While working on any of the parts, the students are free to choose whether they do question A or B first. Also, the proportion of time that is spent on either question A or B in each part is up to the students, as long as the total number of minutes for each part does not exceed five minutes.
9. The scoring of the test will be done by the investigator.

PRE - TEST (TIME 1)

TEST OF CREATIVE ABILITY IN MATHEMATICS

NAME ______________________________ SEX: Boy ____ Girl______
(Print) Last First M.

TOTAL SCORE ____________

SCHOOL ______________________________

TEACHER ______________________________ DATE ______________

ENROLLED IN MATHEMATICS OPTION: YES ____ NO ____

This is a test of your ability to think of a large number of ideas in connection with mathematics.

Look at a sample item.

SAMPLE ITEM:

Use 9, 12 and any other numeral to write true sentences using $=$, $\neq$, $<$, $>$.

SAMPLE RESULTS:

1) $9 + 3 = 12$

2) $9 + 12 \neq 9$

3) $9 + 12 > 0$

Of course, there are many more possible results that could have been written.

There will be 6 different situations somewhat like the one above, two on a page. One example will be included for each item. You will be given five minutes on each page to write down other possible results. Write as many different possible results as you can. Your answers need not be complete sentences. Your score will be the total number of different results that you write in the time given you.

Are there any questions?

STOP HERE! WAIT FOR FURTHER INSTRUCTIONS

PART 1 - 5 minutes

List as many different results as you can.

A. Express one with four fives (no more and no fewer) using the various arithmetical operations (+, X, ÷, -).

Sample result: $1 = \frac{55}{55}$

1) ____

2) ____

3) ____

4) ____

5) ____

6) ____

7) ____

8) ____

9) ____

B. Express 24 with three equal numerals or four equal numerals.

Sample result: $25 - \frac{25}{25} = 24$

1) ____

2) ____

3) ____

4) ____

5) ____

6) ____

7) ____

8) ____

9) ____

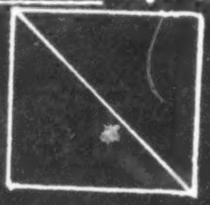
STOP HERE! WAIT FOR FURTHER INSTRUCTIONS

PART 11 - 5 minutes

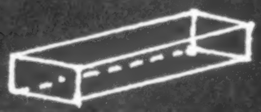
List as many different results as you can.

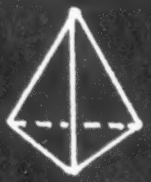
A. Draw as many different ways to divide a square in half.

Sample result:



B. List as many different properties about the following figures:





Sample results: The box has six faces.

1) ____

2) ____

3) ____

4) ____

5) ____

6) ____

7) ____

8) ____

9) ____

STOP HERE! WAIT FOR FURTHER INSTRUCTIONS

PART 111 - 5 minutes

List as many different results as you can.

A. Which one does not belong in the list below and why?

$\sqrt{2}$, 2, 4, 6, 8

Sample result: $\sqrt{2}$ is the only irrational number.

1) ____________________

2) ____________________

3) ____________________

4) ____________________

5) ____________________

6) ____________________

7) ____________________

8) ____________________

9) ____________________

B. Which geometric figures below are alike and why?

Square, Rectangle, Parallelogram, Rhombus, Equilateral triangle

Sample result: Square and Equilateral triangles are both regular figures.

1) ____________________

2) ____________________

3) ____________________

4) ____________________

5) ____________________

6) ____________________

7) ____________________

8) ____________________

9) ____________________

STOP

TEST OF CREATIVE ABILITY IN MATHEMATICS

DIRECTIONS FOR THE TEACHER (TIME 2)

1. This booklet should remain closed until you tell the students to proceed to Part 1.
2. Make sure that the personal information is filled in by all the participants.
3. Use the sample item to explain the nature of this test.
4. As you proceed to Part 1, be certain that everyone understands question A and B of this part. Then time a five minute period for the students to work on Part 1 (questions A and B).
5. Repeat the procedure under 4 for Part 2 and Part 3. Note that each part takes five minutes.
6. Before starting Part 3, draw a square, rectangle, right triangle and an equilateral triangle on the blackboard and label them, so that students do not waste time trying to think out what these figures are.
7. Encourage the students to work as fast as they can in each part.
8. While working on any of the parts, the students are free to choose whether they do question A or B first. Also, the proportion of time that is spent on either question A or B in each part is up to the students, as long as the total number of minutes for each part does not exceed five minutes.
9. The scoring of the test will be done by the investigator.

POST - TEST (TIME 2)

TEST OF CREATIVE ABILITY IN MATHEMATICS

NAME ______________________________ SEX: Boy ___ Girl ___
(Print) Last First M.
SCHOOL ______________________________ TOTAL SCORE ___________
TEACHER ______________________________ DATE ___________
ENROLLED IN MATHEMATICS OPTION: YES ____ NO ____

This is a test of your ability to think of a large number of ideas in connection with mathematics.

Look at a sample item.

SAMPLE ITEM:

Use 9, 12 and any other numeral to write true sentences using =, ≠, <, >.

SAMPLE RESULTS:

1) $9 + 3 = 12$
2) $9 + 12 \neq 9$
3) $9 + 12 > 0$

Of course, there are many more possible results that could have been written.

There will be 6 different situations somewhat like the one above, two on a page. One example will be included for each item. You will be given five minutes on each page to write down other possible results. Write as many different possible results as you can. Your answers need not be complete sentences. Your score will be the total number of different results that you write in the time given you.

Are there any questions?

STOP HERE! WAIT FOR FURTHER INSTRUCTIONS

PART 1 - 5 minutes

List as many different results as you can.

A. Express the one with four fours (no more and no fewer) using the various arithmetic operations (×, +, ÷, -).

Sample results: $1 = \frac{44}{44}$

1) ______________________________

2) ______________________________

3) ______________________________

4) ______________________________

5) ______________________________

6) ______________________________

7) ______________________________

8) ______________________________

9) ______________________________

B. Express 32 with three equal numerals or four equal numerals.

Sample results: $33 - \frac{33}{33} = 32$

1) ______________________________

2) ______________________________

3) ______________________________

4) ______________________________

5) ______________________________

6) ______________________________

7) ______________________________

8) ______________________________

9) ______________________________

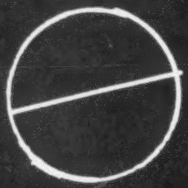
STOP HERE! WAIT FOR FURTHER INSTRUCTIONS

PART 11 - 5 minutes

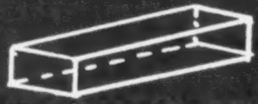
List as many different results as you can.

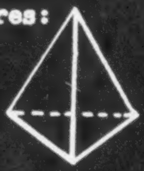
A. Draw as many different ways to divide a circle in half.

Sample results:



B. List as many similar properties about the following figures:





Sample result: Both are three dimensional figures.

1) ______________________________

2) ______________________________

3) ______________________________

4) ______________________________

5) ______________________________

6) ______________________________

7) ______________________________

8) ______________________________

9) ______________________________

STOP HERE! WAIT FOR FURTHER INSTRUCTIONS

PART 111 - 5 minutes

List as many different results as you can.

A. Which one does not belong in the list below and why?

Sample item: $\sqrt{3}$, 3, 6, 9, 27

Sample results: $\sqrt{3}$ is the only irrational number.

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________
5) ______________________________
6) ______________________________
7) ______________________________
8) ______________________________
9) ______________________________

B. Which geometric figures below are different and why?

Square, Rectangle, Right triangle, Equilateral triangle

Sample results: A square has 4 sides and a right triangle has three sides.

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________
5) ______________________________
6) ______________________________
7) ______________________________
8) ______________________________
9) ______________________________

STOP

SUMMARY OF TEST NORMS

Creativity Test (Buckeye, 1971)

Reliability: The reliability of the test was estimated in three ways: (1) the Rulon Split-Halves Formula, (2) the Analysis-of-Variance for Coefficient of Reliability, and (3) the correlation between the scores from the parallel forms.

Rulon Split-Halves Formula		
FORM A (TIME 1)	.62	
FORM B (TIME 2)	.58	
FORM A - FORM B	.73	(using Form A as one-half and Form B as the second half)
Analysis-of-Variance for coefficient of reliability		
FORM A (TIME 1)	.61	
FORM B (TIME 2)	.63	
FORM A - FORM B	.72	(correlation between parallel forms)

Validity: Several approaches were taken:

1. The significance of differences in scores between persons judged "high" and persons judged "low" in creative ability. (A raw score more than one SD from the mean was considered "above average" and a raw score less than one SD from the mean was considered "below average" in creative ability).
2. Three changes were undertaken to improve the test, thus assuring content validity of this instrument.

Norm Information: The norms were established on the basis of five sources: (1) 67 grade one students, (2) 114 grade six students, (3) 446 grade seven students, (4) 491 grade eight students and (5) 573 college students.

Differences in performance between males and females were insignificant, hence the sexes were combined.

The norms are given in terms of raw scores and quartiles

GRADE

QUARTILES		1	6	7	8	College
BELOW AVERAGE	Q_1	2.0	3.1	4.2	7.0	9.4
AVERAGE	Q_2	3.2	5.6	6.3	9.9	16.3
ABOVE AVERAGE	Q_3	4.1	6.7	8.7	12.3	26.8

APPENDIX H

Teacher Interview Instrument

Interview Procedure

Teacher Interview

School: ______________________ Date: ____________

1. Sex: Male ________ Female ________

2. How many university courses in mathematics do you have? ____________

3. Number of years of teaching experience?
    a) Junior high school level? ________
    b) Math B-option? ________
    c) Total years of teaching experience? ________

4. Are you teaching the math B-option as a result of personal choice?

5. How many Ed. CI. courses in mathematics do you have? ____________

6. Do you feel adequately prepared to teach the mathematics B-option? If not, why not?

7. Do you feel that mathematics B-option has a positive effect on:
    a) mathematical fluency?
    b) attitudes toward math and related concepts?
    c) other: explain ______________________________

____

8. Should math B-option continue to be offered in its present structure? Why or Why not?

9. How much structure should be imposed on the mathematics B-option? Why?

10. How do students choose the mathematics B-option?

11. Do students help you to structure the mathematics option?

12. How do students help you structure the mathematics option? Give examples.

13. What are some of the instructional modes that you use in the mathematics option?

14. What are the major problems with resources (facilities, supplies, equipment, etc)?

15. In what grades should the mathematics option be taught? Why?

16. What are some topics that you and your students study in math. option?

BELFAST BOND

17. What are some of your main general objectives that you intend to attain in math. option?

18. Do you feel that math. option should be used for remedial purposes in core mathematics? Why or Why not?

19. Do you enjoy teaching math. option?

20. Should math. option be offered as:
    a) full year course
    b) semestered
    c) other: explain ____________________

21. How do you evaluate students in this course?

22. How many 40 min. periods should be held in math. option each week? (If course is offered for full year)

23. What is the size of your mathematics option class(es)?
    a) less than 15
    b) 15 - 20
    c) 21 - 25
    d) 26 - 30
    e) more than 30

24. What changes would you suggest to make it a better course in the future?

Interview Procedure

In order to place the subject at ease, the investigator attempted to discuss a general topic before commencing with the interview. Then each interviewee was given a copy of the interview schedule and was asked to fill-in the responses as they were read out by the investigator. When answering the questions, each interviewee was told to consider his/her reply as long as desired. Once a response was written down, the interviewee read it out aloud. This was to ensure that the investigator had fully understood the response and that it was in no way ambiguous. The interviewee was told to ask for more elaboration or interpretation of an item if unsure of its meaning. It was also pointed out to the interviewee to answer as accurate as was possible.

APPENDIX I

Varimax Rotated Factor Loadings by Concept of Scales Belonging to the Evaluative Dimension At Time 1 and Time 2

TABLE I.01

VARIMAX ROTATED FACTOR LOADINGS BY CONCEPT OF SCALES BELONGING TO THE EVALUATIVE DIMENSION AT TIME 1.

(BASED ON N = 428)

SCALES	CONCEPTS									
	1	2	3	4	5*	6	7	8	9**	OVER ALL CONCEPTS
1. VALUABLE - WORTHLESS	.67	-.70	-.75	-.81		-.80		-.82	-.79	-.78
2. WEAK - STRONG		.69	.70	.68		.62	.60	.74	.70	.63
3. GOOD - BAD	.63	-.64	-.57	-.77		-.77	-.60			-.75
4. UNFAIR - FAIR				.78		.63	.64		.73	.69
5. FOOLISH - WISE	.72	.69	.54	.81		.69	.75		.71	.78
6. RELAXED - WORRIED					-.71					
7. UNPLEASANT - PLEASANT					.74					
8. EASY - DIFFICULT					-.55					
9. DIRTY - CLEAN					.74		.69			
10. NICE - AWFUL					-.73					
11. DARK - BRIGHT					.67					
12. HAPPY - SAD					-.75					
13. DULL - ALIVE					.60					
14. ACTIVE - PASSIVE					-.53					
15. DISHONEST - HONEST				.68	.57	.62	.56	.60	.70	.64
16. INTERESTING - BORING										
17. MEANINGFUL - MEANINGLESS	.70	-.68	-.60	-.81		-.73		-.78	-.78	-.74
18. UNIMPORTANT - IMPORTANT	-.75	.56	.61	.82		.82		.78	.79	.76

* FACTOR LOADINGS FOR CONCEPT 5 WERE CALCULATED BY OMITTING SCALE #3

** FACTOR LOADINGS FOR CONCEPT 9 WERE CALCULATED BY OMITTING SCALES #3 AND #10

TABLE I. 02

VARIMAX ROTATED FACTOR LOADINGS BY CONCEPT OF SCALES BELONGING TO THE EVALUATIVE DIMENSIONS AT TIME 2.
(BASED ON N = 417)

SCALES	CONCEPTS								
	1	2	3	4	5	6	7	8	9
1. VALUABLE - WORTHLESS	-.80	-.82	.78	-.84	-.77	-.77	-.57	-.79	-.81
2. WEAK - STRONG		.67	-.65	.67	.64	.58	.56	.69	.65
3. GOOD - BAD	-.68	-.79		-.79	-.76	-.68	-.72	-.80	-.75
4. UNFAIR - FAIR		.72		.81	.73	.59	.78	.79	.72
5. FOOLISH - WISE	.68	.70	.67	.82	.65	.69	-.75	.74	.79
6. RELAXED - WORRIED									
7. UNPLEASANT - PLEASANT		.61					.59		
8. EASY - DIFFICULT							-.57		
9. DIRTY - CLEAN				.49			.60		
10. NICE - AWFUL							-.57		
11. DARK - BRIGHT									
12. HAPPY - SAD									
13. DULL - ALIVE									
14. ACTIVE - PASSIVE									
15. DISHONEST - HONEST		.61		.70	.66		.57	.66	.65
16. INTERESTIN G - BORING									
17. MEANINGFUL - MEANINGLESS	-.73	-.78	.64	-.77	-.71	-.73		-.75	-.78
18. UNIMPORTANT - IMPORTANT	.82	.80	-.69	.79	.79	.81		.79	.80